THURSDAY, JULY 9, 1891.

THE UNITED STATES ENTOMOLOGICAL COMMISSION.

Fifth Report of the United States Entomological Commission on Insects Injurious to Forest and Shade Trees. By Alpheus S. Packard, M.D., Ph.D.

VERY valuable Reports have been presented by the United States Entomological Commission from time to time. Among these may be mentioned that upon "The Rocky Mountain Locust," prepared by Prof. Riley in 1878, which is a most exhaustive record of the habits of this terrible pest, and of methods of prevention and remedies against its attacks. Later on, an equally valuable and instructive Report was submitted with regard to the cotton worm (*Aletia argillacea*), very destructive to the cotton plant, whose crop it has reduced in some seasons from 30 to 75 per cent. in the principal cotton-producing States. Both these elaborate works, as might be expected from their authors, Prof. Riley and Dr. Packard, who practically constituted this Entomological Commission, are full of interesting experiments, ingenious contrivances, and subtle devices, to circumvent the insect hordes advancing with the insistance of invading armies.

This Report upon "Insects Injurious to Forest and Shade Trees" is perhaps not so exciting or painfully interesting, as the harm caused to trees is not so directly felt as that occasioned to various food crops and other crops of the field by locusts and caterpillars innumerable, and the name of the insects described therein is legion, and their individual mischief is comparatively small.

As Dr. Packard says, "a volume could be written on the insects living on any single kind of tree, and hereafter it may be expected that the insect population of the oak, elm, poplar, pine, and other trees will be treated of monographically." Kaltenbach, in "Die Pflanzenfeinde, aus der Klasse der Insekten," gives accounts of 537 European species of insects injurious to the oak, 107 to the elm, and 396 to the willow. Perris, a French observer, has recorded no less than 100 species of insects found upon the maritime pine.

The attacks of insects upon forest trees and upon shade trees, or trees planted for shade and ornamentation in parks, streets, and other public places, are becoming far more numerous and serious, just as in the case of all cultivated crops under the sun. In the United States these attacks are creating intense interest, as the forests are of the highest commercial importance, and have been extensively decreased by clearing, by wanton and accidental fires, and other causes. This Report, then, is opportune, and must be of great service, as it demonstrates the sources of the injuries, and suggests means of preventing them or of diminishing them.

The French, German, Austrian, and Italian Departments of Agriculture are giving much attention to this subject, for it is found that the forest trees of these countries are becoming more liable to harm from insects. In Great Britain some kinds of trees, notably of the pine tribe, have suffered much damage from insects hitherto unknown, or, at least, not reckoned as injurious. There are, without doubt, many others unsuspected in British woods and forests, slowly but surely working great mischief.

Dr. Packard shows that trees are attacked in every part and in every conceivable manner by insects. Their roots, leaves, bark, fruit, and twigs are all more or less subject to their visitations. The most curious of those which affect the roots is the "seventeen year" Cicada, whose larvæ remain for over sixteen years attached to the rootlets of the oak, other forest trees, and fruit trees, as the pear and apple. According to Prof. Riley, these larvæ are found at a great depth, sometimes as much as 10 feet below the surface. The female, resembling a locust, deposits long slender eggs in an unbroken line upon the terminal twigs of oak and other trees in May and June. Sometimes the twigs are so "badly stung" by this oviposition that the trees are seriously injured. The length of wood perforated on each branch sometimes varies from one to two and a half feet, averaging probably eighteen inches, and appearing to be the work of one female. From the eggs the larvæ hatch out in six weeks and drop to the ground, in which they live, sucking the roots of the trees for nearly seventeen years, the pupa state lasting but a few days.

A formidable enemy of the "live-oak" (*Quercus virens*) is an enormous beetle, *Mallodon melanopus*, Linn., whose larva, three inches long and an inch in thickness, bores into the roots upon which it lives. As a result of the work of this insect in South Georgia and Florida, "vast tracts, which might otherwise have become forests, enriching the ground with annual deposits of leaves, are reduced to comparatively barren scrub, in which the scattered oak-bushes barely suffice to cover the surface of the sand." The eggs are laid by the beetle in the foot, or collar, of the tree, just below the surface of the ground. It is not known how long the larvæ live, but their life must extend over several years, "since the roots occupied by them grow to a large size, while they show an abnormal development, and become a tangle of vegetable knots. In fact, the entire root in its growth accommodates itself to the requirements of the borer within." The effect on the tree is to kill the original stem, which becomes replaced by a cluster of insignificant and straggling suckers, forming, perhaps, a clump of brushwood.

Among the tree-borers, other than beetles, the oak "carpenter worm," the caterpillar of *Prionoxystus robiniæ*, Peck, is the largest and most destructive. It is larger and far more abundant than the European caterpillar of *Cossus ligniperda*, or goat-moth, belonging to the same family of Cossidæ, but it sinks its tunnels deep in towards the heart of the tree, not confining its mischief to the limbs and large branches like the goat-moth caterpillar. Fitch says of this:—"Of all the wood-boring insects in our land, this is by far the most pernicious, wounding the trees most cruelly. The stateliest oaks in our forests are ruined, probably in every instance where one of these borers obtains a lodgment in their trunks." Another species of Cossus, known as *Cossus centerensis*, bores into poplars. Its appearance and habits also resemble those of the goat-moth, well known in this country.

There are numbers of boring beetles, of the families Buprestidæ, Cerambycidæ, and Scolytidæ, whose larvæ make burrows, passages, and galleries in trees, mainly just under the bark. Of these, the elm-tree borer, *Saperda tridentata*, is prominent, often killing elm-trees by wholesale, both in forests and in public parks. The larvæ bore in the inner bark, making irregular furrows and tunnels upon the surface of the wood, which "is, as it were, tattooed with sinuous grooves, and the tree completely girdled by them in some places." In the State of Illinois attention was attracted to the gradual decay and death of white elms (*Ulmus americanus*) in rows in some towns. The leaves fell off in the summer, and some of the branches died. Finally, the tree perished altogether. On peeling off the bark, half-grown larvæ of *Saperda tridentata* appeared in considerable numbers, and the manner in which the bark had been mined by the Saperdas gave sufficient evidence of the cause of the death of the tree. Prof. Forbes, State Entomologist of Illinois, says: "From the present appearance of the elms throughout the towns of Central Illinois, it seems extremely likely that this pest will totally exterminate this tree, unless it be promptly arrested by general action." It is recommended that all affected trees should be removed and destroyed in autumn and winter, before the beetles have a chance to emerge from the trunks. This beetle is not quite an inch long; its larva is rather more than an inch in length, having a large flat head.

Fir trees, especially the white pine (*Pinus strobus*), the yellow pine (*Pinus mitis*), and *Pinus rigida*, are much injured by the pine borer or "sawyer," *Monohammus confusor*. "I have seen," writes Dr. Packard, "hundreds, perhaps nearly a thousand, dead firs, whose trunks were riddled with the holes of these borers." Dr. Packard cites a correspondent of the *North-Western Lumberman* who reported that "extensive and valuable forests of yellow pine in the Southern States are destroyed by a worm commonly called here a 'sawyer,' or flat head." White pine trees are also much beset by the "wood engraver" bark beetle (*Xyleborus xylographus*, Fitch), so called because it makes beautifully regular and artistic furrows on the surface of the wood under the bark. It is the most common, and probably the most pernicious, of all the insects that infest the forests of white pine in New York State, and of yellow pine in the States south of New York.

A weevil, the white pine weevil (*Pissodes strobi*), frequently spoils the finest white pines in parts of America by placing numerous eggs in the bark of the topmost shoots of fir trees; the larvæ from these make mines in the wood and pith, causing the shoots to wither and die, thereby occasioning a fork, or crook, at this point. This is a very small insect, not three-quarters of an inch long, and the larvæ are not half an inch in length.

There is a mighty army of caterpillars of various moths described in this Report, which devour the foliage of trees of all kinds in American forests and gardens. Several species of Clisiocampa and Gasteropacha, of the Bombycidæ, assail oak, willows, ash, chestnut, apple, and pear trees. These are termed "tent" caterpillars, as they live in webs of a tent-like form, as the *Clisiocampa Neustria*, or lackey moth, in Europe. But the most voracious of caterpillars are the "fall web worms" of the moth *Hyphantria cunea*, Drury. For instance, in 1886, the city of Washington, as well as its vicinity, was entirely overrun by them. All vegetation, except that not agreeable to their tastes, suffered greatly. Fine rows of shade trees, which grace the streets and avenues, were leafless in midsummer, and covered with hairy worms. The pavements were strewn with moultings of the caterpillars and their webs, which were blown about unpleasantly by the wind.

Because they are hairy they have comparatively few enemies, among birds at all events. The "English sparrow," fast becoming as great a nuisance in the United States as the rabbit in Australasia, will not look at them, and has driven away by its pugnacity many birds that would eat them. Fortunately there are insect enemies which prey upon them, as the *Mantis carolina*, or "rear horse," an extraordinary insect of the same family as the "praying" mantis, and the "wheel bug" (*Prionidus cristatus*). Several parasitic insects also greatly check the spread of this moth. One fly, *Telenomus bifidus*, Riley, lays its egg within the tiny egg of the moth, in which all the transformations of the fly take place, and its food and lodging are found. In due time, having cleared out the egg, the fly emerges.

Mr. Bates, in his graphic account of tropical insects, has pictured many that are made to closely resemble their surroundings, for their preservation and other purposes. In his well-known paper on mimicry, he alludes to the insects known as Phasmidæ, or "spectre" insects, as especially typical of this adaptation to circumstances, preserved and augmented, as Darwin says, "through ordinary selection for the sake of protection." Mr. Wallace brings forward the Phasmidæ as striking instances of mimicry, remarking that "it is often the females alone that so strikingly resemble leaves, while the males show only a rude approximation."

Species of this family of Phasmidæ are mischievous to trees in America, principally the oak and the hickory. The chief of these is the *Diapheromera femorata*, Say., popularly called "walking-stick," "walking-leaves," "stick-bug," "spectre," "prairie alligator," "devil's horse." This insect, especially the female, is so like the twigs of trees in colour and appearance, that it is difficult to discover it. It has a habit, too, of stretching out the front legs and feelers, greatly enhancing this resemblance. While the vegetation is green the "walking-sticks" are green; when the foliage changes in the autumn they also change colour; and when the trees are bare of leaves they closely resemble the twigs on which they rest. The eggs are dropped upon the ground from whatever height the females may be, "and, during the latter part of autumn, where the insects are common, one hears a constant pattering, not unlike drops of rain, that results from the abundant dropping of these eggs, which in places lie so thick among and under the dead leaves that they may be scraped up in great quantities." Prof. Riley adds, with regard to these singular creatures and their wonderful resemblance to the oak vegetation upon which they occur, "one cannot help noticing still further resemblances. They are born with the bursting of the buds in the spring; they drop their eggs as the trees drop their seeds, and they commence to fall and perish with the leaves, the later ones persisting, like the last leaves, till the frost cuts them off."

There is not space enough to do more than allude to the sawflies, another class of insects fearfully injurious to trees of divers kinds. Many of these Hymenoptera, as in Great Britain and other European countries, mainly of the genus *Nematus*, clear off the leaves of forest and fruit trees. Others attack firs, notably some species of Lophyrus and Lyda, as the *Lophyrus abietis*, *Lophyrus pinetum*, and *Lophyrus pini-rigidæ*, and some of the Lyda. Cameron, in his monograph of the British phytophagous Hymenoptera, states that there are fifteen species of Lophyrus in North America, and that the species of Lyda are common there.

Lophyrus abietis and *Lophyrus abbotii* appear to do the same harm in America to firs as the *Lophyrus pini* in Scottish fir plantations, whose larvæ not only eat the leaves but the bark of the young shoots, frequently occasioning great losses.

An instructive account is given in this work of the effect of temperature upon insects. It is the fashion in Great Britain to say that insects are killed by hard frosts. But they are not killed in countries—as America, for example—whose winters are far more severe. Dr. Packard, quoting Judeich and Naitsche's "Lehrbuch der Mittel-Europäischen Forstinsektenkunde," observes that "the influence of even very great cold on the normal hybernating stages of our insects is not very great. In the summer of 1854 the 'nun' moth had very generally laid its eggs in Eastern Prussia uncovered on the bark, and these did not freeze in the hard winter of 1854–55. According to the observations of Regener, openly exposed caterpillars of the pine silk-worm endured 10° F. The pupa froze at 21° F., the moth at 19° F. According to Duclaux, the eggs of the silk-worm endure well, remaining two months in a temperature of 17° F. Great fluctuations of temperature during the winter produce an abnormal interruption of the winter's rest or hibernation, and thus cause the death of many insects." It will be noticed that in all these cases the insects were unprotected, whereas there is generally some kind of protection during the winter for insects in all stages, provided by their instinct.

Not the least useful part of the Report is that treating of remedies for insect attacks, and machines and engines for applying them. Arsenical poisons, known as Paris Green and London Purple, are strongly recommended for spraying or syringing trees infested with the larvæ of beetles and sawflies, or the caterpillars of moths. These have been recently introduced into England, being advocated by the Board of Agriculture, but have not been extensively adopted yet, owing to the natural prejudice against the use of poisons. In America they are employed most extensively and with the greatest benefit. By means of these the potato beetle (*Doryphora decemlineata*) was circumvented, and the cotton and boll worms checked, and the onslaughts of many other insects materially lessened. For Aphides, Scale insects, and other insects which suck the sap of leaves, "emulsions" or washes of soft soap, or "jelly soaps," made directly from fish oil and concentrated lye, or whale-oil soap, are prescribed. Also kerosine, naphtha, and petroleum, applied in a fine spray, or mixed with soap and soap jelly, forming "emulsions." These remedies act by contact, being applied principally to insects which do not eat the leaves, as well as by making the surroundings unpleasant and unbearable. Powdered substances, as pyrethrum, hellebore, and sulphur, are not much employed for forest work, but cases frequently arise warranting their use in a limited way. Hellebore, as gooseberry growers in Kent and Cambridgeshire well know, is of especial value against all sawfly larvæ. Sulphur is valuable against the red spider (*Tetranychus telarius*), and is used alone or in connection with emulsions of kerosene.

Numerous machines are in vogue for putting on washes and powders, from the small "knapsack" machine carried on the back, to huge tanks on wheels, fitted with powerful hand-pumps and long lengths of hose, through which liquids are forced to great heights; for very high trees, tall ladders are used, which are set near the trees, upon which men mount, and direct the hose into the topmost branches. For smaller trees and shrubs, a barrel fixed on wheels, having a good force-pump with hose, is adopted. Pumps are also fitted into tanks of all shapes and sizes, and moved from place to place by hand or horse-power. To distribute the liquids there are endless nozzles or jets contrived with much ingenuity to send forth fine mists, or sprays, or continuous volumes. It will suffice to say that the best of these is the cyclone, or Riley nozzle, which is just being introduced into Great Britain.

Foresters, and all concerned in the management of woods and forests, public parks, and gardens, would do well to consult this work for information as to the various insect enemies of trees, and the best means of dealing with them. It is quite impossible in a review to give anything more than a general idea of its scope and nature.

PHYSICAL RELIGION.

Physical Religion. The Gifford Lectures delivered before the University of Glasgow in 1890. By F. Max Müller. (London: Longmans, 1891.)

THE present volume, which embodies the author's second course of Gifford Lectures, with notes and appendices, is devoted to the consideration of "Physical Religion," that is the religion which finds its object the Infinite in or behind the phenomena of Nature. The author's previous writings have made it clear that for the simplest and most abundant manifestation of this form of religion we must go to the Veda, so his first task in the lectures before us is to tell once more the familiar story of the discovery, the character, and the age of the Veda. To this survey four lectures are devoted, and, in conclusion, the author—not without duly considering all that in recent years has been urged to the contrary—reaffirms his conviction that the hymns of the Rig Veda cannot have been collected later than 1000 B.C.

In the sixth lecture the author deals with the evolution of the idea of God. It is often supposed—even by philosophers of repute—to be a sufficient account of the earliest form of religion to say that men worshipped stones and other fetishes as their gods. But, as the professor well remarks—

> "Does it never strike these theorizers that the whole secret of the origin of religion lies in that predicate, *their gods?* Where did the human mind find that concept and that name? That is the problem which has to be solved; everything else is mere child's play."

And he exhibits the process by which Agni (the Vedic god of fire), from being originally nothing but "the mover," came to be called *deva;* and it is this word *deva* which when examined yields the clue to the development, and teaches us a lesson of the highest importance:—

"Guided by language we can see as clearly as possible how, in the case of *deva*, the idea of God grew out of the idea of light, of active light, of an awakening, shining, illuminating, and warming light. We are apt to despise the decayed seed when the majestic oak stands before our eyes, and it may cause a certain dismay in the hearts of some philosophers that the voice of God should first have spoken to man from out the fire. Still, as there is no break between *deva*, bright, as applied to Agni, the fire, and many other powers of nature, and the *Deus optimus maximus* of the Romans—nay, as the God whom the Greeks ignorantly worshipped was the same God whom St. Paul declared unto them—we must learn the lesson, and a most valuable lesson it will turn out to be, that the idea of God is the result of an unbroken historical evolution, call it a development, an unveiling, or a purification, but not of a sudden revelation."

The two following lectures are devoted to the detailed following out of the biography of Agni, who appears in a variety of characters as the sun, the fire on the hearth, lightning, the messenger between gods and men, and priest. Finally, divested of his material character altogether, he is raised to a sublimer level as creator, ruler, and judge. The value of this inquiry, into the details of which we have no space to enter, lies in the fact that it involves the refutation of two objections which are frequently urged—with or without knowledge—against natural religion by the professors of so-called supernatural religion. The first is that natural religion, though it may lead men to a conception of "gods," is powerless to suggest to them the conception of God. This is directly contradicted by the history of Agni, whom we can watch, as it were, passing through many stages of growth until he becomes in the end "a supreme god, *the* Supreme God, till his very name is thrown away, or is recognized as but one out of many names by which ancient seers in their helpless language called that which is, the One and All." Driven from this position, however, the orthodox objector usually takes up another, and contends that the supreme God of natural religion lacks some if not all of the lofty attributes which he is enabled to know and to predicate of his own God by supernatural revelation. But Prof. Max Müller's answer to this objection is equally decided:—

"Trusting to the fragments that have been preserved to us in the Veda, to the remains of the most childish as well as the most exalted thoughts, we may say that natural religion, or the natural faculties of man under the dominion of the natural impressions of the world around us, can lead, nay, has led man step by step to the highest conception of deity, a conception that can hardly be surpassed by any of those well-known definitions of deity which so-called supernatural religions have hitherto claimed as their exclusive property."

In the ninth lecture the Professor leaves for a while the field of his special studies to glance at the history of religious ideas among other peoples than the Âryas of the Veda. And it is noteworthy that he fully recognizes the possibility that Jehovah himself may originally have been a god of fire. But we must protest against the way in which he alludes to Abraham, the legendary founder of Hebrew monotheism, as if his historical character had never been questioned. It is, of course, perfectly open to any one to believe that Abraham was a real individual, who received a "revelation," whatever that word may be defined to mean (see p. 221); but at the same time, in a course of lectures addressed to an academic audience, it should surely have been mentioned that this is an hypothesis, which Renan, for instance, among Semitic scholars, does not even take the trouble to discuss.

In the lecture on the mythological development of Agni, we would call attention to the importance assigned to *riddles* as a cause of the growth and preservation of mythology. To take a simple example:—

"After the Âryas in India had once arrived at the conception that fire was apt to consume the fire-sticks, or that Agni had eaten his father and mother, they seem to have amused themselves by asking such questions as, Who eats his own parents? The answers given would then enter upon many details, more or less far fetched, and the question would continue to be asked between young and old people."

And we think that this is a far more natural explanation of the origin and popularity of such stories than the hypothesis, which has no external evidence to support it, that the Âryas were simply ascribing to Agni the atrocities which they practised themselves.

Finally we come to the question, What can a study of natural religion teach us? "Why," answers Prof. Max Müller, "it teaches us that religion is natural, is real, is inevitable, is universal," and he proceeds to exhibit in detail one or two of the more important implications of this great lesson. With regard to miracles, for instance:—

"Is it not clear that in the eyes of those who believe in the omnipresence of the Moral Governor of the world, miracles, in the ordinary sense of the word, have become impossible, and that to them either every event is miraculous or no event can claim that name. Before the great miracle of the manifestation of God in nature, all other miracles vanish. There is but one eternal miracle, the revelation of the Infinite in the finite."

The Professor then shows by a series of examples that the tendency to ascribe a miraculous birth to the founders of religions is natural and widespread, and asks by what right people claim a different character for the legends of the birth of Jesus than for the similar legends told of Buddha and Mohammed. The honesty and candour with which the question is stated are specially welcome at the present time, when it is becoming the fashion with ecclesiastical amateurs in Biblical criticism to blow hot and cold, as it were, with the same infallible mouth—that is, to reject the miracles of the Old Testament, but retain those of the New. For instance, in a recent manifesto, highly recommended as providing a temporary shelter for the destitution of the semi-reasonable, there is, on the one hand, some tall talk about the imaginative performances of "a dramatizing Jew" in the Old Testament, while, on the other hand, we are gravely informed that "the Church can insist upon the truth" of all that is recorded in the New Testament. That this cheap substitute for criticism will eventually be discredited, even in England, we have no doubt whatever. Meanwhile we cordially recommend the present volume not only for the interest of its subject-matter, but as an example of the masterly application of the only method which in these inquiries can lead to sure results.

THE KARWENDEL ALPS.

Das Karwendelgebirge. Von A. Rothpletz. Separat-Abdruck aus der *Zeitschrift des Deutschen und Oesterreichischen Alpenvereins.* With Map. (München, 1888.)

THE Karwendel Alps are a mountain mass lying to the north of the valley of the Inn, between Innsbruck and Jenbach, and bounded on the east by the Achensee, on the north and west by the upper valley of the Isar, and on the south roughly by a line drawn along the Hinterauthal (the highest part of the valley of that river) to Schwaz, in the Innthal. This region has been explored and mapped by Herr Rothpletz, with the assistance of other workers, and it is described as consisting of three roughly parallel ranges. Though their peaks do not attain to a very great elevation, the higher summits ranging from 6500 feet to rather over 8200 feet, their grand cliffs of cream-coloured limestone and their pine-clad slopes afford very beautiful scenery.

In this part of the Alps the mountain masses are wholly composed of sedimentary deposits which range from the Trias to the Neocomian. The oldest are the *Werfener Schichten*, a mass of sandy shales and sandstones, often containing numerous flakes of biotite, indicative, in all probability, of the denudation of the crystalline masses which form the floor of the Mesozoic rocks in the Alpine region. They correspond in age roughly with the upper part of the Bunter in Germany and England. Then comes the remainder of the Trias, including the Muschelkalk, followed by the representatives of the Rhætic, the Lias, and other Jurassic deposits, and a part of the Neocomian, a marine series from top to bottom. Neither the last nor the Jurassic system attains to a great thickness, but both the Rhætic and the Trias are represented by great masses of rock. In the one, the *Haupt-dolomit* occasionally attains to a thickness of 500 metres; in the other, one member, the *Myophorienschichten*, is said to be equally important. Careful descriptions of each subdivision, with lists of the more characteristic fossils, are given in the memoir. Neither Cretaceous nor Tertiary strata occur to bridge over the interval between the Neocomian and the superficial Glacial or post-Glacial deposits.

The physical history of these ranges is made the subject of an elaborate discussion. Herr Rothpletz is of opinion that, at some epoch after the Neocomian and before the commencement of the folding process by which the existing Alpine ranges were upraised, the region was affected by movements which produced a system of faults. In consequence of these, a zone of upheaval was bordered on either side by one of depression. These caused important modifications in the great east and west folds, to which the Eastern Alps are due; the rocks in the two troughs were crushed together; the upheaved tracts were upthrust. A folding plate represents an ideal section of the region after the "pre-Alpine" movements, side by side with one which shows its present state.

There can be no doubt that, in explaining the physical structure of the Alps, we have to take account of much more than the later Tertiary foldings to which the formation of the mountain-chain is due, such as the old irregularities of the pre-Mesozoic land-surface; and any important system of faults could not fail to produce very marked effects. Also, it seems indubitable that there were interruptions to the downward movement in parts of the Alpine area during the later Mesozoic and the earlier Tertiary times, which may, very probably, have caused faults such as are described by Herr Rothpletz. These, it may be noticed, appear to run obliquely to the general trend of the main folds.

Herr Rothpletz, in conclusion, expresses an opinion adverse to those geologists who consider that glaciers have played an important part in the erosion of valleys, and calls especial attention to the Soiernsee, a small lake lying in a fold of the *Plattenkalk*, which, in his opinion, indicates that "the movement of flexure acted in this case with greater rapidity than the erosive action of streams or glacier."

The geological map is on a scale of 1 : 50,000; the separate memoir, of octavo size, contains 76 pages, with 9 plates and 29 smaller illustrations. It also includes a full list of works bearing on the district. So far as we can judge, it is an elaborate and valuable contribution to the knowledge of a region but little known to English travellers, who, however, occasionally pass very near to it along the margin of the beautiful Achensee.

T. G. B.

OUR BOOK SHELF.

Graphical Statics. Two Treatises on the Graphical Calculus and Reciprocal Figures in Graphical Statics. By Luigi Cremona. Translated by Thomas Hudson Beare, Professor of Engineering and Applied Mechanics, Heriot-Watt College, Edinburgh. (Oxford: Clarendon Press, 1890.)

TREATISES on this and allied subjects of the Graphical Calculus are not uncommon in our language; but, although nowadays indispensable for engineering purposes, the subject does not flourish in our theoretical courses of instruction.

The theorems of Graphics once stated—that is, drawn out carefully on the drawing-board—are obvious, or at least do not lend themselves to verbal written demonstration, so that for purposes of competitive examination, the controlling influence of modern education, the subject of Graphical Statics and Calculation is useless.

Geometrical drawing is not taught in our public schools and Universities; and the student in a technical college only requires the bare minimum of Graphics, sufficient to enable him to pass on to practical developments; so that we fear the elegant abstract theorems on the use of signs in Geometry, as applied to lines and areas, graphical multiplication, division, involution and evolution, solution of equations, centroids, rectification and graphical analysis generally, will receive but slight attention.

There is a note of defiance in the Author's Preface to the English edition of "Reciprocal Figures in Graphical Statics" (the second treatise): "At a time when it was the general opinion that problems in engineering could be solved by mathematical analysis only, Culmann's genius suddenly created Graphical Statics, and revealed how many applications graphical methods and the theories of modern (projective) geometry possessed," &c.

The preface to "Geometry of Position," by R. H. Graham, must be consulted for the counterblast in favour of Maxwell's claim to the honour of priority.

A. G. G.

The History of Commerce in Europe. By H. de B. Gibbins. With Maps. (London: Macmillan and Co., 1891.)

THE chief defect of this little book is that the author does not bring into sufficient prominence the geographical element in commercial history. What are the geographical conditions which have favoured the growth of particular industries in special localities? And in what ways have such conditions affected the interchange of commodities between one part of the world and another? Mr. Gibbins has not, of course, neglected these questions, but he scarcely seems to have realized that they are of vital importance for the scientific presentation of his subject. On the other hand, his appreciation of the action of historical causes in the development of commerce is excellent; and for a general view of commercial progress his manual will be of much service to students. After an introductory chapter he considers "ancient commerce," by which he means the commerce of the Phœnicians, the Carthaginians, and the Greek colonies. He then deals with the ancient Greek States and Rome as trading communities. Next comes "mediæval commerce," in connection with which he has much that is interesting to say about the Italian cities, the Hansa towns, mediæval trade routes and fairs, the manufacturing centres of Europe, and other topics. Under "modern commerce" he treats of the commercial empires in the East, the commercial empires in the West, English commerce from the sixteenth to the eighteenth century, European commerce in the seventeenth and eighteenth centuries, the industrial revolution in England and the Continental wars (1793), modern English commerce, and the development of commerce in France, Germany, Holland, Russia, and the other European States. The maps are very good, and add considerably to the value of the text. We may also note that the volume includes a useful series of questions on the various chapters, and two appendices, in one of which there is a list of British produce and manufactures in 1840 and 1889, while the other consists of a table showing the present colonial empires of European Powers.

LETTERS TO THE EDITOR.

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The Albert University.

THE remarks of Mr. Thiselton Dyer upon the draft charter of the "Albert University" have my fullest concurrence. I have never desired to see such a University as is sketched in that charter set up in London by the side of the existing University. The charter and the general scheme of its proposals never obtained the sanction of the professoriate of University College whilst I was a member of that body; and many of us were as active as circumstances allowed us to be, in opposing its federal principles and bureaucratic tendency. That University and King's Colleges should be united in some way to form a University is one proposition: that the University should take the particular form excogitated by Sir George Young is another. It is well that it should be generally known that the elaborate (and to my mind mischievous) constitution sketched in the draft charter of the Albert University is the product of the devotion and ingenuity of Sir George Young, an active member of the Council of University College.

I was not aware, when I wrote in NATURE some weeks ago on this subject, that the Lord President of the Privy Council had determined to set aside the recommendations of the late Royal Commission, and to hurry through a formal inquiry into the draft charter propounded by the Councils of University and King's Colleges.

So long as the matter was in the hands of the Commission, this charter, put forward by the Councils of the two Colleges, was merely one of many suggestions as to the proper form which a new or reconstituted University of London should take. It was notorious that the Councils' support of Sir George Young's scheme did not represent the attitude either of the Professors of the two Colleges or of those throughout the country who have special knowledge of Universities and of the best methods of academical organization.

The Royal Commission of 1888 was appointed to inquire "whether any and what kind of new University or powers is or are required for the advancement of higher education in London." The Commission took a large amount of evidence from interested parties—practically none from persons outside the London institutions concerned—and recommended that the University of London should be invited to meet the needs set forth in such documents as the draft charter of the Albert University, by some modifications of its constitution and procedure. In the event of a failure on the part of the University to do this, the Commissioners recommended *that the matter should be referred back to them.*

My support of the claim of University and King's Colleges to be incorporated as some kind of University has always depended on the assumption that no Commission or other serious authority could possibly accede blindly, and without full consultation of the best authorities in the land, to the scheme embodied in the Albert University draft charter. The Commissioners took, it seems to me, the only rational view of that charter—namely, that it might serve as a suggestion to the University in Burlington Gardens for a reform which would meet, at any rate, some of the objections raised to the existing constitution of the latter body.

Lord Cranbrook, however, seems anxious to hurry on the shelving if not the solution of the University of London question. Instead of referring the matter back to the Commissioners, he takes the matter out of their hands. The Commissioners have *never reported in answer to the question set before them.* No one knows whether they think any, and, if so, what kind of new University is required in London.

Having failed to settle the question for the time being by such a reform of the University in Burlington Gardens as Mr. Dyer advocates, the Commissioners ought—according to their own recommendation—to have been allowed to proceed further. "It is now ascertained," they would have said, "that the existing University of London will not reform itself in the way we have suggested: what sort of University shall we now recommend, if any?" They might have suggested the coercion of the Convocation of Burlington Gardens by an Act of Parliament; or they might have—after inquiring from authorities in Oxford, Cambridge, Dublin, Edinburgh, and wherever else some understanding of the nature and objects of Universities happens by chance to dwell—recommended the formation of a professorial University in London similar to those of Scotland and of Germany.

I confess that it has always been my hope, though not my expectation, that they would take the latter course. I am sure that if they had proceeded to take the evidence of experts in University matters, and had not attached undue importance to the proposals of competing corporations, they would have found the balance of unprejudiced opinion to be in favour of a "professorial" rather than a "federal" University. The difficulty they would have had to contend with would have been that some of their own body, and nearly every witness whom they lately examined, are very far from having a clear idea as to what are the possible forms of University organization, what the merits and the demerits respectively of the "federal" and the "professorial" scheme as now in practice in Europe. This is obvious enough from the printed "Minutes of Evidence taken before the Royal Commissioners appointed to &c.," which can be purchased of Messrs. Eyre and Spottiswoode for about half-a-crown.

But whatever else the late Royal Commission might have done, I cannot believe that they would have proposed to set up so extraordinary and useless a piece of complicated machinery as the Albert University (of the draft charter) by the side of Burlington Gardens. The draft charter, having failed to reform the existing University of London, ought, one would have thought, to have been torn up.

I quite agree with Mr. Dyer that it is little short of monstrous for the Government to set up in London *two* such organizations as Burlington Gardens and the federal Albert; there is the strongest reason for insisting that there shall be only one of them, whether Convocation likes it or not.

Meanwhile, we are no nearer than we were seven years ago to the formation in London of a Senatus Academicus which shall retain in the metropolis—in contact with its statesmen, lawyers, physicians, authors, and the intelligent men and women of wealth and leisure—the strongest and best of our scholars, historians, physicists, and biologists. Is it well that the President of the Royal Society of London should have to travel from Glasgow to the meetings of that body? that its senior Secretary should spend his life in Cambridge? and that there is absolutely no professorship in the metropolitan area which can, by virtue of its dignity or its pecuniary value, entice men from the seclusion of provincial Universities? The draft charter of the Albert University does not even attempt to supply such a want. It actually makes the London professor more a creature of competition and the servant of red-tape officialism than he is at this moment.

E. RAY LANKESTER.

MR. THISELTON DYER has done good service in pointing out the nature of the proposed Albert University, which, unfortunately, seems not unlikely to be the result of the discussions that have been going on for the last six or eight years with respect to a "Teaching University for London." Should the charter petitioned for by the Councils of University and King's Colleges be granted, it will not constitute a teaching University in any real sense, but, as Mr. Thiselton Dyer says, an institution very similar to what the present University of London was as constituted by the original charter of 1837. There are, of course, differences of organization and machinery, such as the institution of Assemblies of Faculties and Boards of Studies (which the existing University might institute next week, if it saw fit), but there is little or nothing that can be looked upon as a difference of principle. The nearest approach to this are the provisions: (1) that the Colleges whose students are to be eligible as candidates for degrees shall have a certain amount of representation on the governing body of the University; (2) that the claim of additional Colleges to enter the University shall be decided by the governing body of the University, subject to appeal to the Queen in Council (instead of, as in the charter of 1837, being decided on directly by the Crown); (3) that "the University may appoint lecturers independently of a College or medical school to give instruction in any subject, whether it be or be not included in a Faculty."

With the exception of this last provision, slipped in at the end of Section V., "*University Degrees and Certificates*," as though modestly shunning the notice that a separate heading might call to it, there is no allusion from beginning to end of the draft charter to any teaching to be done by or through the University as such. If it comes into existence, it will be a mere examining University over again. Such a scheme can go no appreciable way towards remedying the existing defects of University organization in London. It is not easy to see what public advantages are likely to result from it. Seeing that it is put forward as representing the views of University College, London, it does not seem irrelevant to the present stage of the discussion to say that the scheme of the Albert University has never been submitted to a general meeting of the Governors of the College.

University College, London. G. CAREY FOSTER.

The Draper Catalogue.

ON p. 133 of the current volume of NATURE (June 11) Mr. Espin gives a comparison of the Draper Catalogue of Stellar Spectra with the catalogues of Vogel and Dunér. Vol. xxvi. of the *Harvard Annals*, of which the first part will be distributed in a few days, discusses at length the deviations from Vogel and also from the similar catalogue of Konkoly. A second examination was made on photographic plates having a long exposure of those stars which appeared discordant. Since spectra of the first type pass by insensible degrees into the second, and these in turn into the third, no two observers would agree on the exact points of distinction. Moreover, different characteristics would distinguish the photographic and visual portions of the spectra (*H. C. Annals*, xxvi. pp. 177, 189). Some discrepancies, as in the case of the three fourth-type stars which are erroneously entered in the Draper Catalogue, are due to errors of identification (xxvi. p. 192). The photographic spectra of faint third-type stars are always indistinguishable from those of the second type (xxvi. p. 178). See also remarks following Table II. of vol. xxvii. The bright lines cited by Mr. Espin are probably portions of the spectra contained between dark bands or lines (xxvii. p. 3). Spectra are difficult to classify when measured as faint as 6·5; not when the final magnitude is brighter than 6·5, as might be inferred from Mr. Espin's reference (xxvii., preface).

EDWARD C. PICKERING.

Cambridge, U.S., June 22.

The Cuckoo.

I DO not know if the hibernating of swallows and other summer visitors is still a debated question or not, but the following account of a cuckoo may be of interest to some of your readers.

In the month of August a young cuckoo was taken from its nest and kept in the house, where it lived and throve—until one day in November, when it escaped and could not be found. But in the following March, during the usual spring cleaning, this very bird was discovered on a shelf in the back kitchen, hidden away behind some old pots and pans, still alive, and asleep, with all its feathers off, and clothed only in down, the feathers lying in a heap round the body. The rude awakening which the cuckoo received was fatal to its existence, for it survived only for a few hours.

E. W. P.

Colour-Associations with Numerals, &c.

THE following record of experiments extending over a period of nearly ten years, under exceptionally good conditions, appears to me to be worthy of attention. A preliminary note on the subject was printed in *Science*, vol. vi. No. 137, 1885, p. 242, part of which is reproduced below.

In 1880, while I was in Washington, I read Mr. F. Galton's note on "Visualized Numerals," in NATURE, vol. xxi. p. 252.

After I came to Wisconsin—probably late in 1881, or early in 1882—I mentioned my own entire inability to visualize numerals or anything else of the kind to a member of the University faculty, Prof. Owen. I was interested to learn that, when a boy, he had always conceived the vowel sounds as having colour, and that he still retained some traces of this early habit.

I spoke of this subject in my house shortly after; and my daughter Mildred, then about seven years old, said she also had colours for the days of the week, as follows: Monday, *blue*; Tuesday, *pink*; Wednesday, *brown* or *grey*; Thursday, *brown* or *grey*; Friday, *white*; Saturday, *pure white*; Sunday, *black*. It was said laughingly, and at the time it passed to my mind as a joke—that she wished in sport to assume the idiosyncrasies of elder persons. A few days after, I questioned her on these colours, and she gave the same replies. It was again spoken of as a kind of a joke and a question of memory, but I wrote the colours down in my memorandum-book for 1882. A year later I produced this, and again questioned her—this time seriously—and found her answers the same as at first. Again, on August 5, 1885, her replies were the same. The tenacity of a child's memory is very remarkable; but I was convinced this was not a case of memory and imagination, but a true phenomenon of the kind referred to. I therefore went farther, and asked her if there were any other phenomena of the same sort (she was now ten and a half years old). I found that each of the letters of the alphabet had a colour to her, as follows:—

A, *white*; B, *blue*; C, *yellow*, *cream colour*; D, *dark blue*; E, *red*; F, *black*; G, *green*; H, *white*; I, *black*; J, *grey*, *brown*; K, *grey*; L, *dark blue*; M, N, *brown*, not much colour; O, *yellow*; P, *green*; Q (?); R, *brown*; S, *yellow*; T, *green*; U, *yellow*; V, *white*; W, *brown*; X, Y, not much colour; Z, *greenish*.

The prevalence of yellow and green, and the scarcity of reds and pinks, are noteworthy. I found that she knew these colours instantly, and when I asked for them in any order. What is more remarkable, she could instantly name the brown letters in a group, the black ones, &c. Apparently she did not require to pass the alphabet in review to decide this. The numbers also had colours to her, as follows:—

1, *black*; 2, *cream colour*; 3, *light blue*; 4, *brown*; 5, *white*; 6, *crimson*, *pink*; 7, *greenish*; 8, *white*; 9, *greenish* (?); 10, *brown*; 11, *black*; 12, *cream colour*; 13, *blue*; 14, *brown*; 15, *white*; that is, 11 had the same colour as 1, 12 as 2, 13 as 3, &c.

These colours were also named instantly, and in any order, and in groups.

Case of Miss Mildred Holden.

Age ... ... Year	= 7 1882	= 8 1883	= 10½ August 1885	= 13 December 1887	= 14½ June 1889	= 16½ June 1891
Monday ...	Blue	Blue	Blue	Blue	Blue	Blue
Tuesday ...	Pink	Pink	Pink	Pink	Pink	Pink
Wednesday...	Brown *or* grey	Brown *or* grey	Brown *or* grey	Brownish	Brownish	Brownish-grey—more brown than grey
Thursday ...	Brown *or* grey	Brown *or* grey	Brown *or* grey	Brownish	Brownish	
Friday ...	White	White	White	Whitish	White	White
Saturday ...	Pure white	White	White	Cream ; light yellow	Cream colour	Cream colour
Sunday ...	Black	Black	Black	Black	Black	Black
A	—	—	White	White	White	White
B	—	—	Blue	Blue	Blue	Blue
C	—	—	Yellow ; cream	Cream colour	Cream	Cream
D	—	—	Dark blue	Blue	Blue	Blue
E	—	—	Red	Red	Red	Light red
F	—	—	Black	Brown	Brown	Brown
G	—	—	Green	Green	Green	Green
H	—	—	White	White	White	White
I	—	—	Black	Black	Black	Black
J	—	—	Grey ; brown	Brown	Brown	Brown
K	—	—	Grey	Grey	Grey (?)	Grey
L	—	—	Dark blue	Blue	Blue	Blue
M	—	—	Brown	Brown	Brown	Brown
N	—	—	Brown	Brown	Brown	Brown
O	—	—	Yellow	Cream colour	Cream (?)	Cream
P	—	—	Green	Green	Green	Green
Q	—	—	?	Purple	Purple	Purple
R	—	—	Brown	Brown	Brown	Brown
S	—	—	Yellow	Yellow	Cream	Yellow
T	—	—	Green	Green	Green	Green
U	—	—	Yellow	Cream colour	Cream	Cream
V	—	—	White	White	—	White, I think, not sure
W	—	—	Brown	Brown	Brown	Brown
X	—	—	Not much colour	Red	Red	Red
Y	—	—		Cream colour	Cream	Cream
Z	—	—	Greenish	Green	Green	Green
1	—	—	Black	Black	Black	Black
2	—	—	Cream	Cream	Cream	Cream
3	—	—	Light Blue	Blue	Blue	Blue
4	—	—	Brown	Brown	Brown	Brown
5	—	—	White	White	White	White
6	—	—	Crimson ; pink	Pinkish	Pink	Pink
7	—	—	Greenish	Green	Green	Green
8	—	—	White	Cream colour	White	Cream
9	—	—	Greenish	Blue	Bluish-green?[1]	Dark blue
10	—	—	Brown	Brown	Black ?	Black *or* brown

[1] If anything.

Note.—The column for June 1891 was sent to me in a letter, as written in the table, except that *Wednesday* and *Thursday* are described as "brownish-grey, with little dots," and *Friday* as "white, with dots." The letter says:—"Is this right? I write this out without giving much thought to it—writing as fast as I can write. I am not quite definite in my mind as to the colours of 9, 10, G, T, K, O, Q, S, V; but the others have never changed. The days of the week I *never* think of without thinking of their corresponding colours. They have always remained the same. I don't quite remember if I have ever told you about the dots before, but they have always been there, and are like minute pencil marks showing through the colour. *Tuesday* is slightly dotted."

The table gives the results of the earlier experiments together with others which have been subsequently obtained. The later experiments have been made under circumstances which are peculiarly favourable—usually by correspondence during my daughter's absence at school.

The table undoubtedly represents vivid and permanent associations of colour with numerals, letters, &c. If we collect the various signs which correspond to a given colour, it appears, on the whole and in a general way, that the colour is associated with the *sound* rather than with the *form* of a letter. For example, G, P, T, Z are *green*; A, H, eight, are *white*; V, Friday, five, are *white*; C, S, Saturday, are yellow, &c. There are numerous exceptions to this, however, and it is by no means proved that there is a real law here. I simply make the suggestion on account of its bearing on the question whether or no we can think without words. It is clear that many experiments, such as are exhibited in the table, must be made before the time will arrive for definite conclusions to be drawn. Perhaps this brief note may induce others to print the results of similar investigations.

EDWARD S. HOLDEN.

Mount Hamilton, June.

Erratic Barometric Depression of May 23-29, and Hailstorm of May 24.

In connection with the very interesting letter of the Rev. Clement Ley (on p. 150), descriptive of the barometric depression which passed over these isles towards the end of last month, the following extract from a letter of mine published in the local press, with a view of obtaining further information, but without success, may be of interest. At the time when the centre of the depression lay over the mouth of the Thames, as mentioned by Mr. Ley, this neighbourhood was being visited by a thunderstorm of great severity and lengthy duration, and at 6 p.m. the rain gave place to hail, and "In the short space of twenty minutes the ground and roofs of houses were covered with a compact layer of frozen rain-drops, which at the end of half an hour (6.30 p.m.), when the storm had abated and given place again to rain, I found to have an average depth of 0·75 inch, though the stones were then reduced to about half their original size. . . . But few of the hailstones, which were nearly all ovarious in form, were smaller than 0·375 by 0·250 inch, and three which I picked up at random at 6.10 p.m. when the storm was at its height, measured respectively 0·065 by 0·051 inch, 0·437 by 0·562 inch, and a spherical one had a diameter of 0·5 inch." Such large hailstones are, I believe, rarely met with in storms near London. This one seems to have been confined to a comparatively small area, the hail falling in its greatest severity at Leyton, and not extending much beyond Walthamstow, Stratford, West Ham, and here.

B. J. HOPKINS.

Forest Gate, E., June 22.

"An Alphabet of Motions."

I HAVE lately found the following extract in Arthur Young's "Travels in France, in 1787," which I fancy is not generally known. It occurs in Betham Edwards's late edition (Bell and Sons), at p. 96.

"In the evening to Mons. Lomond. . . . In electricity he has made a remarkable discovery. You write two or three words on a paper; he takes it with him into a room and turns a machine inclosed in a cylindrical case, at the top of which is an electrometer, a small fine pith ball; a wire connects with a similar cylinder and electrometer in a distant apartment; and his wife, by remarking the corresponding motions of the ball, writes down the words they indicate, from which it appears he has formed an alphabet of motions. As the length of the wire makes no difference in the effect, a correspondence might be carried on at any distance."

J. S. DISMORR.

Stewart House, Wrotham Road, Gravesend, June 24.

On a Cycle in Weather Changes.

IT is known that Prof. Brueckner, of Berne, in a work on "Klimaschwankungen," published a short time ago, offers a large amount of evidence for the view that our globe is subject to a weather-cycle of about 35 years, a series of cold and wet years, or warm and dry ones, recurring at about that interval. Has it been noticed in this connection that Bacon, in one of his essays (No. lviii. "Of Vicissitude of Things"), makes reference to such a cycle? The passage is as follows:—"There is a toy which I have heard, and I would not have it given over, but waited upon a little. They say it is observed in the Low Countries (I know not in what part) that every five-and-thirty years the same kind and suit of weathers comes again; as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like, and they call it the *prime*. It is a thing I do the rather mention, because, computing backwards, I have found the same concurrence."

A. B. M.

THE FORECAST OF THE INDIAN MONSOON RAINS.

AFTER an interval of twelve more or less prosperous years, following on the memorable Madras famine of 1876-77, and the drought and fearful mortality of North-Western India in 1877-78, India seems once more to have entered on one of those prolonged series of adverse seasons which put a severe strain on the protective powers of its Government, and, despite all human precaution, bring suffering, disease, and premature death to thousands of its industrious peasants, and to even larger numbers of the impoverished outcasts who form the lowest fringe of its teeming population, fighting the precarious battle of their life at all times on the verge of destitution. The drought in Ganjam in the autumn of 1889 has been followed by the failure of the late autumnal rains over the central districts of the Carnatic towards the close of last year, and the too familiar machinery of relief works for the able-bodied, and doles of food to the helpless indigent, has been in active operation for several months past in the districts around Madras. Another monsoon, another season of those periodical rains on which depends the fate of millions, is now due and overdue, and there comes from India an ominous note of warning that there is reason to fear that more than one great province of the empire, or certain portions of them, may again this year lie parched and barren, their young crops withering and shrivelled under the dry west wind, while, month after month, men scan with ever-growing anxiety the pale dust-obscured sky and scattered ball-shaped clouds that never mass themselves to rain-clouds, but mock their hopes with the promise of showers that never fall to moisten the sun-baked soil.

And this warning, alas! is no mere guesswork of credulous and speculative minds, such as in these latitudes certain of our would-be weather prophets love to put forth at hazard, to furnish the topic of a day's gossip to the million, or haply to win for themselves a summer day's reputation with the uninstructed, in the event of a successful issue. Certainty, indeed, there is not and cannot be till science shall have extended its domain far beyond its present limits; but, in India, the stately march of the seasons is but little obstructed by the vicissitudes of fugitive cyclones and anticyclones, that originate we know not how, and disappear by some concurrence of causes equally beyond our ken. In the tropics, and in the realm of the monsoons, all weather phenomena are more massive and slower in progress, and each great change of seasons is heralded by signs which, if we can as yet but vaguely interpret them, are at least recognizable as such, and, with a certain allowance for possible error, must be accepted as timely monitors of what is likely to follow. These it is that, whether rightly or wrongly deciphered, furnish the basis for the present warning. To those who, like the present writer, have followed for many months past, not without anxious interest, the telegraphic and other reports periodically transmitted from India, it comes as no surprise, but as a confirmation of misgivings long entertained though only now backed by the warranty of full official evidence. The events of the next three months may yet belie the present indications, and that they may do so is still our fervent hope; but it would be folly to ignore them, and to shut our eyes to the probabilities that they seem to portend.

For the last eight years it has been one of the duties of the Indian Meteorological Department, some time early in June, to prepare, for the information of Government and the public, a forecast of the probable character of the summer monsoon, based on the reports of the snowfall on the Himalaya and the western mountains, and on the indications afforded by the weather of the previous winter and spring. The possibility of framing such a forecast was in a measure foreseen by the Famine Commissioners appointed by the Home Government after the disastrous famines of 1876 and 1877, of which Commission General R. Strachey, the true founder of the Meteorological Department of India, was the scientific member; and it is in no small degree due to the weighty advocacy of this Commission that the Department owes its present extension and importance. Mr. Eliot's forecast for the coming season is now before us. It sets forth at length the general and special grounds on which he bases his conclusions; and these, though duly guarded by the reminder of their essentially empirical character, and of the unavoidable imperfection of our information regarding certain important data, are expressed in terms that leave unhappily no doubt of the adverse character of the outlook.

Attention was first directed to the apparent connection of the Himalayan snowfall with the prevalence of dry land winds in India, in the year 1877, and about the same time the late Prof. S. A. Hill and Mr. Douglas Archibald showed that, as a general rule, an unusual cold weather rainfall in Northern India was followed by a deficient rainfall in the ensuing summer monsoon. In a paper published in the Proceedings of the Royal Society in 1884, these two classes of facts were shown to be merely different phases of the same phenomenon, and a summary was given of all the evidence on the subject that had been accumulated up to that date. Since then, there has been but one year of heavy Himalayan snowfall, viz. 1885, and in that year the rains were greatly delayed on the Bombay coast, and were very deficient in North-Western India in June, July, and September, commencing late, and terminating early. During the past winter and spring the snowfall on the North-Western Himalaya and the mountains of Afghanistan and Baluchistan has been excessive—indeed, as Mr. Eliot states, unprecedented during the last twenty-five years—and from the reports received from the civil officers and observatories in the mountain districts, he estimates that an average fall of 40 feet, if not considerably more, must have fallen over all the higher ranges, from Murree eastward to Garhwal, if not to Central Nepal. That it was the same on the less accessible range of the Hindu Kush we have reason to believe from the casual reports that were received during the last winter, and we know that in Southern Europe and even in Northern Africa, snow fell down to the sea-level, and was such as has hardly been experienced certainly during the greater part of the present century. The phenomenon has therefore been one of widespread incidence, and indicates some remarkable and rare condition of those higher strata of the atmosphere which, we have now reason to believe, are the seat of the more important changes that regulate the vicissitudes of the weather of the globe.

Concurrently with this exceptional extension of the snowfall to low latitudes of the temperate zone, the Indian registers afford evidence of certain abnormal features, which are such as have been noticed on former occasions of unusual snowfall on the North-West Himalaya, and the bearing of which on the weakness of the summer monsoon is more clearly traceable. In fact, they tend to link the two phenomena together, whether we regard them as the common effects of some more remote agency, or as displaying the different steps of a physical sequence of cause and effect. The most important of these are : the unusual rainfall over the whole of Northern India in the past winter and spring, amounting to from two to three times the average in the Punjab, where it was heaviest ; a prevailing low temperature in Northern and especially North-Western India, together with a corresponding excess of temperature in Assam, Burma, and Southern India ; and finally, a persistent excess of atmospheric pressure in the former region and a deficiency in the latter. These anomalous features have characterized more or less all the months of the present year, especially March and May. As estimated by European standards, the anomalies of this last element may indeed appear small. For instance, the mean excess at Peshawar in May was 0·052 inch, at Mooltan 0·041, and at Quetta 0·049 inch, while the deficiency at Calicut was 0·040 inch, and at Sibsagar 0·031 inch. Taken together, they constitute an anomalous gradient from north-west to south and east of something under a tenth of a barometric inch in distances of 1300 and 1500 miles. But in India such differences are relatively large, and, as former experience has abundantly shown, very significant. As temporary phenomena they might indeed be of little importance ; but, lasting as they have done through nearly half a year, they point to an anomalous state of the atmosphere which is evidently persistent, and is distinctly adverse to the northern incursion of the summer monsoon. Taking the general mean of all parts of the empire, the atmospheric pressure has been above the average in every month of the present year. With respect to the winds, Mr. Eliot remarks :—"South-easterly winds have been unusually prevalent in Bengal and Behar during the months of April and May, and north-westerly and northerly winds on the west coast of India as far south as Cochin. The unusual prevalence of north-westerly winds on the Bombay coast in the month of May was one of the features of the weather in 1876, 1883, and 1885, in which years the monsoon was greatly retarded on that coast."

Finally, after reviewing the chief characteristics of other years in which the Himalayan snowfall has been heavier than usual, Mr. Eliot draws the following conclusions with respect to the probable character of the monsoon rains of the present year in the different provinces of India :—

"(1) Snowfall conditions on the Western Himalayas, &c., and the pressure conditions in India are very unfavourable to the establishment of a strong and early monsoon on the Bombay coast. It is very probable that it will not be established in full strength on the Bombay coast before the third or fourth week in June, and it is probable that it will be below its average strength, and may be withdrawn from Upper India earlier than usual in September.

"(2) The snowfall conditions in the Eastern Himalayas, and the pressure conditions in North-Eastern India and Burma, are favourable to the advance of a moderately strong or strong monsoon in the Bay of Bengal earlier than usual, and to its establishment in Burma and Bengal before or about its normal period," and Burma, Bengal, and Assam are expected to receive an average or more than an average rainfall ; Behar and the eastern districts of the North-West Provinces about the usual amount. In Southern India it is thought probable that the rains may be retarded, but that Malabar and Southern India generally are likely to receive favourable rain during the monsoon.

On the other hand, it is pointed out that "conditions are very unfavourable for Rajputana, and also to some extent in Guzerat, the southern districts of the Punjab, and the western districts of the North-West Provinces. It is probable the rainfall will be more or less deficient over the whole of that area, and possible that the deficiency may be large and serious." In Northern Bombay and Berar it is thought that "the rainfall is more likely to be slightly deficient than up to its normal amount," and that in the Central Provinces it will be "fairly normal."

From this abstract it will be seen that the region in which drought is chiefly to be anticipated is the western provinces of Northern India, comprising Rajputana, Guzerat, the southern districts of the Punjab, and the western districts of the North-West Provinces ; provinces the average rainfall of which does not exceed between 20 and 30 inches, and which time after time have been the seat of disastrous famines. Now there is one consideration relevant to this subject of which no mention is made in Mr. Eliot's report, and which, notwithstanding that its bearing is purely empirical, cannot, we think, be entirely disregarded when dealing with the question of probabilities. This is the fact, first pointed out by the Famine Commissioners, that between 1782 and 1877, on no less than five occasions, a drought in Southern India was followed by a drought in Northern or rather North-Western India in the succeeding year. It does not seem possible, in the present state of our knowledge, even to suggest any physical explanation of this remarkable sequence, but it has been repeated too often to allow of our regarding it as purely fortuitous, and unfortunately it only tends to strengthen the probability of the adverse conditions inferred by Mr. Eliot from the existing state of things.

It must be confessed, then, that, according to our present means of judgment, the present outlook is by no means hopeful. The mere fact of a retardation of the monsoon rains would not in itself afford cause for serious anxiety. According to the latest report from Madras, indeed, this part of Mr. Eliot's forecast seems to have been justified by the event, for on June 26 the Governor of Madras telegraphs that the south-west monsoon rains have not set in properly in the interior, and are very light even on the Malabar coast,[1] whereas the date at which they are

[1] We have taken the liberty of altering the punctuation of this telegram to bring it into accordance with sense and fact.

usually expected is the end of May or the beginning of June. The really critical months in North-Western India are August and September. If the rainfall is then abundant and continuous up to the end of the third week in September, with a final shower or two at the end of the month, all may yet be well; but if the rainfall of these months is light and partial, and if it ceases prematurely, the crops form no ear, and they perish and dry up in the warm dry west winds that speedily follow. And it is these crops that furnish the food staples of the agricultural classes of India. H. F. B.

PHYSICAL SCIENCE FOR ARTISTS.[1]

II.

WE next come to the absorption of light. I do not know whether you have had any opportunity yet in your laboratory course of observing the spectral phenomena produced when white light, or say solar light, is absorbed by different substances. The white light is broken up by the dispersion of the prisms into a rainbow band; while it is possible, by one means or another, one substance or another, to filch out of this coloured band some of the constituent colours, now at one end, now at another, sometimes in different parts at once; and when this has been done, the light which finally reaches the eye may be of any colour, as is evidenced by the different colours you see in a stained glass window. This is what happens also by the absorption of our atmosphere, due in all probability in great part to the contained aqueous vapour. The sun is white in the middle of the day and red at sunset. The blue part of the light, which, when all the colours reach us, looks white, has been taken away, and practically nothing but red is left; only certain parts of the spectrum are left. It is easy, after two or three hours' experiments with the absorption of light by different media, to grasp the laws which govern sunset colours precisely, as it is easy in the anatomical school to study the facts relating to the human form, particular muscles and the like. A diligent student will thus have the world of colour at his feet. This can, however, only be done by one interested in physical science, and I think it should be done by anyone who wishes to deal with landscapes or seascapes, anything, in fact, which has to do with the natural world. The results obtained in this way of course come to us pictorially, chiefly in the colour of sky and water and in the colours of clouds, and they are mixed up in pictures by the knowledge, or want of knowledge, of the artist who paints these various reflecting surfaces. The reflecting surface, whether water or cloud, or what not, must not only be true in colour, but perfectly formed, in order to give an absolutely perfect and pleasant picture.

Here I think it is that the need of physical science is greatest, and I do not know, in fact, that there ought not to be some kind of an examination in a College like this which shall insure that anyone who is going to take up the study of art is not colour-blind. This is done in the case of sailors and engine-drivers, and I think it should be done in the case of artists. There are pictures which have apparently been painted by colour-blind people; and of course it should be a subject of great regret that so much skill has been wasted in consequence of such a malformation as this.

It may be, of course, that in some cases, where the thing may be charitably supposed to arise from a physical defect, it is the result of mere ignorance, or want of observing power; but if that be so, then my point is proved, because it is clear that a good scientific training will cause these objectionable, impossible, colours to be gradually eliminated from our exhibitions. On the other hand, when we look at a gallery of pictures, one is so frequently rewarded by the exquisite truth of some of them, that one could very well look over the defects of others, if all thoughts of the possible progress of art achievement were banished from one's mind.

Some of you may perhaps have read Mr. Ruskin's chapter on clouds. The scientific basis of the various cloud forms, however, you will not find there. Now when we consider that in land- and sea-scapes the sky, and especially the clouds, are among the most important reflectors of light, whether white or coloured, the form of the cloud is absolutely of very high importance. If the light is reflected by an absolutely impossible cloud, your delight at the colour, which may be true, is absolutely checked by the treatment of the anatomy of the cloud. Here, again, we touch a distinct branch of physical science. An acquaintance with the various forms of condensation assumed by aqueous vapour under the various conditions of the atmosphere would certainly keep one right where one would be very apt to go wrong. I referred, also, to the reflection of sunlight, whether white or coloured by absorption, by water. Here, I think, is a region where physical science is also helpful. There can be no question that the grandest display of colour in the natural world is a sunrise or sunset, either at sea, or where there is a water surface to bring in a second series of reflection phenomena. As a rule, perhaps, if the water be somewhat land-locked, or at all events not broken up by strong wind, the effect is finer, and this perhaps is one of the reasons, but only one, why the sunsets seen off the west coast of Scotland are so remarkable.

This, however, does not always hold. I have seen a sunrise in the Mediterranean when passing the Straits of Gibraltar twenty years ago, which was so magnificent, that not only is it still present in my mind's eye, but all the sailors who were swabbing the deck at the time ceased work and simply gazed at it entranced. It promised to be a cloudy sunrise, but suddenly the cloud pall melted into mackerel sky, and the sun at rising payed out different colours on the high and low patches; the sea was choppy, and every facet of every wave, and every facet of a facet, being turned to different parts of the sky; these picked up and reflected to the eye different colours, so that every wave looked like a casket of gems.

The red or yellow colours on the clouds depend simply upon the thickness of the atmosphere which the sunlight has traversed to reach them; the colour depends absolutely upon the light received from the sun, and it has nothing to do with the apparent angular distance from the sun in your picture; but while all this change is going on in the clouds the sky itself will be zoned above the horizon from the red to the blue overhead, and in addition to that, you will get the greater luminosity nearer the sun's place. But further than that the sky will not go, because it cannot. At the same height above the horizon you must have absolutely the same sky colour. Now that is a very obvious conclusion. You will always note the greatest possible distinction between the colour of the pure sky and of the clouds. A favourite *sky* colour in sunsets is green. I have seen no green *clouds* except in pictures.

I have noted a few of those pictures this year, which, in my opinion, and I only give it for what it is worth, are remarkable for their truth, or for the absence of it, in different degrees. The numbers are those of the Royal Academy Catalogue, unless otherwise stated :—

Clouds.—Good colour, 351.
Good form, 288, 600.
Good colour and form, 238.
Water.—Good colour, 630, 1029.
Good surface, 682, 759, 1013. New Gallery, 102, 120.

With great deference I must, until convinced to the contrary, hold that much of the colour in the following

[1] Continued from p. 178.

pictures is *impossible*—543, 1028, 176, 192, 515; it is bad in 203, 498, 586, 602, 1044, 1071.

The cloud forms in 498, 536, and 966 are unlike anything I have seen in any quarter of the world.

But cloud is not the only thing we have to deal with. There is a still finer form of aqueous vapour which shows itself as *atmosphere;* its function is to soften distant outlines, to gradually assimilate colours, laying, so to speak, its own upon them, and then, again, to soften even this. So that distant vistas of hills and vales first become blue in prevailing tone, but the most distant ones lose this, and fade to a more neutral tint.

These things this year are admirably rendered in 1130. 293 offends by the impossible hardness of the hill on the right of the picture.

To most of you the terms selective *absorption* and selective *reflection* of colour are familiar; of the latter an admirable study is to be found in 1062. For reflection badly managed, study 145 in the New Gallery. The artist seems to be under the impression that some birds have a special capacity for reflecting colour.

Of special studies of various natural objects, I think the following in the German Exhibition are worth examination: a glacier (287); cloudy moonlight (433); careful study of light-grading (but sun should be more luminous in the latter) (52, 343).

It is not a little singular that we should find such a close association between bad cloud forms and bad colour. It was a true instinct which led Mr. Ruskin to treat of these matters in his "Modern Painters," but why did he not go further into the real basis—the real grit of it all, instead of confining himself to the mere fringe of these great subjects? It was, I expect, because the possible connection between science and art was less recognized then even than it is now. But is it too late? No one could touch the questions still with more sympathy than Mr. Ruskin.

But to come back to the pictures. Almost, if not quite as good as 600, is No. 50 in the German Exhibition. We find in 630 a careful study of colour. The most wonderful colour which can be got on nearly still water is that you sometimes see at sunrise or sunset with a good green or yellowish sky near the horizon, and a perfectly blue sky overhead. In that case every unit of the surface (every undulation) will reflect to your eye a certain amount of horizon-light and a certain amount of blue sky, and the total result will be a sea of molten steel. Another point in this connection is this: if your surface is even, you can get a reflection of this kind from several surfaces besides water. I was in Egypt last winter, and I saw a wonderful sunset, looking out from the little quay at Ismailia. The sand of the desert lay beyond and round the water in the foreground, which was more or less bluish; the lake, in fact, is bounded by sandbanks of no great elevation, the canal coming in at one end and running out at the other.

In the day-time in full sunshine the sand is yellow, as yellow as it can be, and at sunset it is grey-white. There is nothing very remarkable in the sky, but the intense blue in the sky overhead. There is no aqueous vapour to absorb, and therefore there is no colour. But wait for the afterglow! when you get sunlight, reflected from the clouds or sky, which reaches your eye after two transmissions through the lower air; then you can get colour, and you do get it. What you see is the most exquisite violet halo, and the colours with which we are familiar here more or less; but the striking thing is the intense violet halo in the sky, and the warming up of colour till the sunset place is reached. Well, now, what is the effect of that upon the landscape? Everything is turned green, for the simple reason that the only constituent common to the colour which reaches, and is reflected most readily by, the sand, is the tint of green: the sands change, as if by magic, into a wonderful chlorophyll green. Now, I venture to think that the artist who endeavours to work out problems of this kind will be more likely to paint a beautiful picture than the one who copies nature merely, and this brings me into strict harmony with the Academy motto. It seems to me that physical science may in this way, if associated with the study of art, give us new possibilities in the art future that will transcend anything that we know of now, and the time will certainly come, ultimately, when the highest art will result from the study of natural science and the science of the human form.

Seeing that already artists spend years in the study of only one part of the field of observation, they must surely in time come to the conclusion that it would be better to annex other branches.

It would not be right if I concluded what I have to say without calling attention to the important remarks made by Mr. Briton Rivière, on science in relation to painting, at the Edinburgh Art Congress:—

"Whatever may have been done in other lines of human energy during the Victorian age, there can be no question that its most remarkable achievements, both theoretical and practical, have been those of science. . . . The art of the painter has not escaped its influence. On one side, and a very important one—that of realism—the side which furnishes the language—*i.e.* the signs and symbols which express the idea of the artist—there is a wide front open to the influence of science; and on that side art has not been slow or unwilling to follow the advice of science, or ungrateful for the valuable help it has afforded. According to my theory, this supremacy of science would have influenced art under any circumstances, but it has been able to do so through the very method and language of art itself.

"Will this influence help or retard the influence of art? My answer is, it may do either, according to the manner in which it is received and used by the artist. If the painter resolutely holds the belief that painting is a language, and a work of art the expression of an idea, and uses science, and all that it has discovered and teaches, to enable him better to understand his signs and symbols, viz. the material facts of nature, so that by means of them he may express himself correctly, just as a writer has behind him the philologist to busy himself about the derivation and meaning of words, and the grammarian to show him how to place these words so as to produce the meaning he requires—if, I say, the painter so receives and uses the knowledge and appliances of science, then I think the cause of art will be much advanced by science, and works produced under its influence will be stronger and richer than they could possibly have been without it. On the other hand, if the painter allows this scientific knowledge of the material or realistic part of his work to obscure the purely artistic or ideal part of it, to obscure instead of to intensify the *idea;* and if, carried away by the material wonders of the 'thing' which science has unfolded, he forgets the 'thought' altogether, then assuredly, however true he may have shown himself to be to the cause of science, that of art will suffer at his hands—indeed, may be lost altogether. For I feel sure that most of my brother artists will agree with me that it is possible for a picture to be scientifically true and have no art at all in it; and, on the other hand, to contain several scientific blunders and yet be a great work of art."

It will be seen, then, that I have ventured to-day to preach no new doctrine to you: even my gloss on the Academy motto is endorsed by Mr. Briton Rivière.

But I can go further than this, and quote Prof. Helmholtz in support of the gloss. You should all read his admirable lecture "On the Relation of Optics to Painting."[1] In it he remarks, "The artist cannot transcribe Nature: he must translate her;" and he adds, "This translation may give us an impression, in the highest

[1] "Popular Scientific Lectures," Helmholtz, 2nd Series, p. 135. (Longmans, 1881.)

degree distinct and forcible, not merely of the objects themselves, but even of the greatly altered intensities of light under which we view them. . . . Thus the imitation of Nature in the picture is at the same time an ennobling of the impression on the senses."

Let me congratulate you on the fact that here, at all events, the importance of physical science in its relation to art is not forgotten. J. NORMAN LOCKYER.

LUMINOUS CLOUDS.

IN an article contributed to NATURE on November 20, 1890 (vol. xliii. p. 59), Herr O. Jesse (of the Royal Observatory of Berlin) gave an account of his observations of luminous clouds. He has recently submitted to the Prussian Royal Academy of Sciences a record of later work; and, as the subject is one of considerable interest, it may be worth while to translate his paper.[1]

With regard to the results, already briefly noted, obtained in the summer of 1890, I have now to report more precisely, that with the help of the grant made by the Academy of Sciences we were able, during the period when the phenomenon appeared, to secure a collection of photographs which afford rich material for study.

On this as on previous occasions the clouds were visible only between the end of May and the beginning of August. They appeared for the first time, in 1890, on May 26; for the last time—and then there was only a feeble trace of them—at the beginning of August. The phenomenon, therefore, was seen within nearly four weeks of the summer solstice—before and after it—but chiefly after it.

Since my last report, I have received confirmation of the statement that the time when the phenomenon appears in the southern hemisphere has a corresponding relation to the summer solstice there. Unfortunately, however, more precise facts with regard to place, &c., in the southern hemisphere, are still lacking.

During the period between May 26 and July 24, 1890, we obtained altogether 180 photographs of luminous clouds at Steglitz, Rathenow, and Nauen, and at the Observatory of Urania, Berlin. Of these photographs, 75 are suitable for the determination of height, inasmuch as they were secured at the same time in at least two different places. Thirty of the photographs may be used for the determination of the speed and direction of the movements of the clouds, because their representations of the clouds were taken at proper intervals at one and the same place. The remaining photographs are adapted for investigations relating to the dimensions of the clouds and their structure.

The phenomenon was again less bright than it had been in the preceding year. Only when the atmosphere was exceptionally transparent was there an approach to the former brilliancy. The aggregations of these masses of particles are obviously becoming thinner, as may also be perceived from the more distinct appearance of certain relations of structure, like the ridge and rib formations (wave formations) mentioned in my last report. Formerly these were concealed by superposition and apparent interference of a greater richness of analogous strata; now the characteristic lines of the configurations consisting of these ridge and rib formations present themselves more simply and in greater isolation.

It has now been proved more successfully than before that the ridges or longitudinal strips lie parallel to, while the ribs or cross strips are almost at right angles to, the direction of the movement of the entire cloud. Further, we made on different days several series of measurements of the distances of the ribs (wave-crests) from one another with the following groups of results:—

		Kilom.
Mean value of the distances of	9 wave-crests ...	8·3
,, ,, ,,	10 ,, ...	9·9
,, ,, ,,	10 ,, ...	8·4
	Average ...	8·9

Especially striking, last summer, was the difference between the clearness with which the clouds appeared in the morning hours, and that with which they appeared at the corresponding times before midnight.

With regard to the height of the luminous clouds in the summer of 1890 the measurements, so far as they were definitely calculated, gave the mean value of 82 kilom., agreeing almost exactly with the value of nearly 83 kilom., deduced from my photographs of 1889.

The persistence from year to year—now for the first time shown with sufficient accuracy—of the distance, and therefore of the position of the level surface of the phenomenon, would alone deserve to be recorded as a scientific fact of great importance.

As for the speed and directions of the movements, it was again found that the chief component of the movement was directed from east to west, and amounted to nearly 100 metres in the second, while the speed of the revolution of the zone of the earth above which the clouds were placed is about 240 metres in the second from west to east.

There was also a smaller and variable component in the direction of the meridian. This was directed from north to south at the times at which we have hitherto obtained tolerably secure determinations of movement.

The points of view from which the phenomenon of luminous clouds, on the ground of the observations hitherto made, is to be regarded, are already numerous. There is still, however, a wide field for research in connection with the questions, What are the forces which make the phenomenon appear chiefly in the morning hours? and, What is the nature of those forces which cause the movement of the clouds to be mainly from the north-east, and drive them from the northern to the southern hemisphere and back again? Then the question as to the height of the phenomenon in different latitudes is probably of great importance for the constitution of our atmosphere; and not less interesting is the question relating to the material of which the luminous clouds are composed. Unfortunately the interest taken by the scientific world in this remarkable phenomenon is in general so small that during the short time the phenomenon will probably present itself we can scarcely expect to obtain for these questions answers that shall be to any considerable extent satisfactory.

[1] "Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin," 1891, xxvi. Sitzung der physikalisch-mathematischen Classe, vom 28 Mai. "Untersuchungen über die sogenannten leuchtenden Wolken," von O. Jesse, Steglitz.

WILHELM EDUARD WEBER.

THE venerable physicist, Wilhelm Eduard Weber, whose death on June 23 we shortly announced last week, was born at Wittenberg on October 24, 1804, the second of three sons of Michael Weber, Professor of Positive Divinity at Wittenberg. He studied at the University of Halle, where Schweigger was then Professor of Physics; he took his Doctor's degree in 1826, became Privatdocent in the following year, and Professor-Extraordinary of Physics in 1828. In 1831 he was called to Göttingen to succeed Johann Tobias Mayer in the Chair of Physics, and remained there till 1837. Among other results of the death in this year of King William IV., there came about serious changes in the University of Göttingen. Queen Victoria being excluded from the throne of Hanover, by the operation of the Salic law, her uncle, Ernest Augustus, Duke of Cumberland, became King of Hanover. This prince held high views as to the powers of hereditary rulers. In his view the narrow liberties enjoyed by his subjects, under the Constitution reluctantly granted by William IV. in 1833, were excessive and intolerable. He suspended the Constitution, and thereby called forth vigorous protests from Dahlmann and other Professors of the Hanoverian University. As a punishment, seven of them—Dahlmann, Weber, the two Grimms (Jacob and Wilhelm), Albrecht, Gervinus, and Ewald—were ejected from their chairs, and Gervinus, Dahlmann, and Jacob Grimm were even expelled from the country. From this time Weber lived for some years in retirement, but in 1843 he accepted the Professorship of Physics in Leipzig (in succession to Fechner), and in 1849 he returned to his former position in the University of Göttingen. He was in Göttingen at the time of his death.

Wilhelm Weber's eldest brother, Ernst Heinrich, was the celebrated Professor of Anatomy and Physiology at Leipzig. He was born at Wittenberg in 1795, and died at Leipzig in 1878, having been elected a Foreign Member of the Royal Society of London in 1862. The youngest of the three brothers, Eduard Friedrich, was also highly distinguished as an anatomist, and held office for many years in the University of Leipzig.

Weber's first contribution to science at once took rank as a scientific classic, a position it is likely to keep for many years to come. This was "Die Wellenlehre auf Experimente gegründet," a volume of 574 pages, and 18 copper plates, nearly all engraved by the authors, published in 1825 by the brothers Ernst and Wilhelm Weber, and embodying the results of numberless original experiments and observations. One of the most striking results of these investigations was the discovery that, when a regular series of waves follow each other along the surface of water, the particles at the surface describe vertical circles whose plane is parallel to the direction of propagation of the waves, and those lower down ellipses of which the vertical axis becomes smaller and smaller with increasing depth. As to the composition of this work, the authors say that it grew up as the result of such constant and intimate communication between them with regard to all parts, that it is impossible to assign to either of them the separate authorship of any distinct portions.

For several years Weber continued to occupy himself mainly with questions of acoustics, on which he published various papers of importance. In 1833 he published, in conjunction with his brother, Eduard Friedrich, a memorable investigation into the mechanism of walking "Mechanik der menschlichen Gehwerkzeuge").

But it is chiefly by his magnetic and electrical researches that Weber's place in the history of science is marked. These are contained for the most part in the "Resultate aus den Beobachtungen des magnetischen Vereins," published by Gauss and Weber from 1837 to 1843, and in Weber's "Elektrodynamische Maassbestimmungen" (published in collected form in 1864, though the first paper dates from 1846). In this series of papers Weber showed for the first time how methods of absolute measurement, analogous to those which Gauss had very shortly before shown to be applicable to magnetic measurements, could be extended into the region of electricity. Before this time Ampère's splendid discoveries as to the laws of the mutual forces between magnets and conductors traversed by electric currents, or between two such conductors, had been made known, and G. S. Ohm had established once for all the relations between electrical resistance, electromotive force, and strength of current; but, nevertheless, there was as yet no settled system for the measurement and statement of electrical quantities themselves. Until Weber's time electrical measurements were merely comparisons between magnitudes of the same kind: the resistance of one conductor could be compared with that of a particular piece of wire, the electromotive force of one battery could be compared with that of another; but that the value of an electrical quantity could be stated without reference to any quantity of the same kind, and in terms not involving any physical constants but the units of length, time, and mass, was as yet an entirely new conception. Weber, however, not only showed that such a system of measurements was theoretically possible, but in a series of most masterly experimental investigations he showed how it could be practically carried out. Our countryman Sir William Thomson was one of the very first men of science to recognize the fundamental character and far-reaching importance of Weber's work; and owing mainly to his clear-sighted advocacy of the absolute system of measurement, this system was from the first adopted as the basis for the operations of the British Association Committee on Electrical Standards, appointed originally in 1862. This system has now become so familiar to electricians, and is taken so much as a matter of course, that it requires some mental effort to recall the state of science when it did not exist, and to appreciate the intellectual greatness of the man to whom it is due. If we consider method and point of view, rather than acquired results, it is not too much to say that the idea of absolute measurements, underlying as it does the conception of the conservation of energy, constitutes the most characteristic difference between modern physics and the physics of the early part of our century. And to no one man is so large a share in this great step due as to Wilhelm Eduard Weber.

Weber was a Corresponding Member of the Institute of France. He was elected a Foreign Member of the Royal Society in 1850. G. C. F.

A SOUVENIR OF FARADAY.

THE following letter, written by an old friend of Faraday's and of mine, long since dead, may interest your readers, now that we are celebrating the centenary of Faraday's birth. It came in reply to one in which I asked Mr. Ward's assistance in preparing an obituary notice of Faraday for the *Chemical News*.

WILLIAM CROOKES.

Cornwall, August 30, 1867.

DEAR CROOKES,—I should be proud indeed to be the spokesman of the chemical world in doing honour to Faraday's illustrious name on the occasion of his accession to immortality.

But I should not dare to meddle with the laurels on so august a brow, without many days and nights of earnest research and meditation, to fit me for summing up, without omission, the splendid list of his imperishable labours.

Only in this reverential spirit of earnest solicitude to do aright, which is, if I mistake not, the philosophical counterpart of prayer—of the religious feeling—could so solemn a duty be fitly undertaken.

Only with the aid of other minds, kindred with Faraday's in genius, and filled with the light of his manifold discoveries, could any one man's mind become an adequate mirror to reflect the gigantic Shadow that has just passed to its place in futurity.

For the present it is my fate to fulfil much humbler duties—which, having undertaken, I have no right to set aside. For duty must still be done, even when such appeals as yours set the wings of the caged lark trembling, and point him upwards to his barred out home.

I must remain, therefore, a unit among the millions whose hearts do silent homage to the illustrious dead; and can but watch from afar the starry coronation of which you invite me to be minister.

So best, perhaps. For, after all, the name and fame of

Faraday transcend all pomp of celebration, all burning words of praise. For whose the pen to weave so bright a glory as that electric fire which glows, through all the ages, round his brow, who first drew lightning from the lodestone, as Franklin drew it from the sky?

In the moment of separation that little spark breaks forth—instantaneous yet eternal. It is but one vivid point of the radiance that encircles his name, yet of itself it is glory enough.

From that spark a new branch of science has sprung, and under its creator's name, were it mine to carve his epitaph, these three should be the chosen words:—

FULMEN ERIPUIT FERRO!

Ever yours faithfully,

F. O. WARD.

NOTES

WE print elsewhere an account of the fourth annual meeting of the National Association for the Promotion of Technical and Secondary Education. After the meeting an important conference was held, and it is now hoped that all the influences which are tending towards the establishment of a proper system of technical instruction in England may soon be thoroughly organized. Next week we shall have something to say about the work of the conference and about the Association's report.

THE *conversazione* given by the President of the Institution of Electrical Engineers, Prof. Crookes, F.R.S., and Mrs. Crookes, on Monday evening, was brilliantly successful. It was held in the galleries of the Royal Institute of Painters in Water Colours, Piccadilly. There were about 800 guests, among whom were many eminent men of science.

ON Tuesday evening the Fellows of the Royal Meteorological Society and their friends dined together at the Holborn Restaurant, to celebrate the entrance of the Society upon its new premises in Great George Street, Westminster. Mr. B. Latham, the President, occupied the chair. Mr. A. R. Binnie (Engineer to the London County Council) proposed "The Royal Meteorological Society," and Mr. G. J. Symons responded. Mr. Latham, replying to the toast of "The President," referred to the enormous amount of records in the possession of the Society. All they now wanted was a few more members. However, they had gone on increasing, and were now in a prosperous state, as they had been able to collect from the members of the Society a considerable sum of money, which had been funded, and the interest on which would meet the expenses of the new establishment. The Society now possessed one of the finest meteorological libraries in the world, and one which would be of enormous value to future generations.

WE are glad to note that the Marine Biological Association have now only three unoccupied tables. Many investigators are taking advantage of the facilities offered them at Plymouth.

THE Exhibition Committee of the Photographic Society of Great Britain announce that the annual exhibition of that Society will be held at the Gallery of the Royal Society of Painters in Water Colours, Pall Mall East, from Monday, September 28, until Thursday, November 12 next. The exhibition will be open daily (Sundays excepted) from 10 a.m. to 5 p.m., and on Monday, Wednesday, Thursday, and Saturday evenings from 7 p.m. to 10 p.m. Medals will be awarded for artistic, scientific, and technical excellence of photographs, for lantern transparencies, and for apparatus.

THE Pacific Postal Telegraph Company had lately a gathering of some 500 guests at the opening of a new telegraph office in San Francisco. After shortly describing the various instruments, Mr. Storrer, the superintendent, said he was often asked how long it took to telegraph to different places and get a reply. He would therefore now send a telegram to Portland, New York, Washington, Seattle, Tacoma, Canso (Nova Scotia), and London, inquiring about the weather. The first reply came from Portland in 3 minutes, "Weather fine"; the next from New York in 3 minutes 10 seconds, "Misty and warm"; Washington in minutes 11 seconds, "Misty and warm"; Seattle in 3 minutes 21 seconds, "Misty and calm"; Tacoma in 3 minutes 28 seconds, "Misty, cool, and calm"; Canso, Nova Scotia, in 4 minutes 20 seconds, "Cold and misty"; while the answer "Misty and cold" came from London in 6 minutes 22 seconds.

THE Governors of the Royal Holloway College have appointed Miss M. W. Robertson to the Resident Lectureship in Natural Science. Miss Robertson, who is now a lecturer on the staff of Alexandra College, Dublin, has taken the degrees of B.A. and M.A., with high honours in chemistry and physics, at the Royal University of Ireland, and has also gained the University Studentship in Experimental Science.

THE Education Department has issued a memorandum, by Mr. J. G. Fitch, on the working of the free school system in America, France, and Belgium.

THE death of M. Rodolphe Kœppelin, a distinguished chemist, is announced. He was born at Colmar in 1810, and from 1828 to 1859 held the Chair of Physics and Natural History at the College of his native town. For many years he was intimately connected with the Agricultural Society of the Upper Rhine, and, as a chemist, he was able to render great services to the agriculturists of his department. After the Franco-German war, M. Kœppelin quitted Alsace, and settled in Paris, where he was regarded as one of the most eminent members of the Alsatian colony.

IN another part of the paper we print a report, by Herr O. Jesse, of his observations of luminous clouds in the summer of 1890. We learn from Herr Jesse that on the night of June 25–26 last the luminous clouds were again very visible at Steglitz and Nauen, and that they were photographed eight times simultaneously at these two places. Writing to us from Sunderland on July 1, Mr. T. W. Backhouse says there was a fine display of the luminous clouds during the previous night, their motion being, "as usual, from a north-easterly direction." Mr. D. J. Rowan informs us that on the same night, from 11.30 p.m. to 12.30 a.m., the clouds, as seen at Kingstown, co. Dublin, "appeared well-developed on a polar arc of 30° and at a mean altitude of 5°." They had been faintly visible at Kingstown on June 3, 7, and 9. It is astonishing that no observer seems yet to have had energy and intelligence enough to take spectroscopic photographs of these striking phenomena.

ACCORDING to a telegram from Melbourne, dated July 4, the Swedish-Australian Antarctic Committee of the Victorian branch of the Royal Geographical Society, which was formed to raise subscriptions in order to take advantage of Baron Nordenskiöld's offer to equip an expedition to the Antarctic regions, announces that a sum of £3000 only is required to complete arrangements, and that there is every prospect of the expedition starting in about fifteen months' time. It is expected that the expedition, in addition to its geographical and other scientific discoveries, will be the means of opening up extensive whale and other fisheries in the Antarctic seas.

WE learn from the *Botanical Gazette* that Lieut. R. E. Peary, of the U.S. Navy, proposes to reach the North Pole on foot through Greenland, starting from Whale Sound, and expecting to be absent from 1½ to 2½ years. He states that the region about Whale Sound is rich in Arctic plants, Kane having brought over 106 species of Phanerogams and 42 of Cryptogams, several of which were new, but that very little has been done in its investigation since that time.

THE danger of using arsenical preparations for the poisoning of plants is illustrated by the fact that Dr. B. L. Robinson, assistant in the Gray Herbarium, Cambridge, U.S.A., has been compelled to resign his position owing to ill-health resulting from this cause. It is stated that the poisoning of plants has now been entirely abandoned in the herbarium; the tightness of the cases, and constant handling of the sheets being relied on to preserve the specimens.

MR. SPENSER LE MARCHANT MOORE has been appointed botanist to the Matto Grosso Gold and Explorations Concessions Expedition, which is about to depart for Brazil.

A NEW botanical journal has just been started, devoted to the diseases of plants, *Zeitschrift für Pflanzenkrankheiten*, edited by Dr. Sorauer, and published at Stuttgart.

DR. JOHN MURRAY contributes to the *Journal of Botany* for July a very interesting account of the Clyde sea-area, its physical characters, and the chief features of its natural history. This sea-area is a natural system of deep-sea basins or lochs in the west of Scotland, communicating southward with the Irish Channel by a single opening between the Mull of Cantyre and the shores of Wigtown and Ayr. It has a water surface of about 12,000 square miles; its greatest depth is 107, and its mean depth about 29 fathoms. There is a great variety in the pelagic fauna and flora in the surface and intermediate layers of water, the abundance and the species of organisms varying in the different layers according to the seasons, and even in different years. There is likewise a great variety in the bottom-living fauna and flora, which varies according to the nature and depth of the bottom in the different parts of the area. In some of the deeper lochs a few animals are met with which do not usually occur in more open situations around our coasts till a depth of 200 or 300 fathoms is reached. Some of these forms are limited to one loch on the west coast; for instance, *Conchœcia elegans*, which is abundant in Loch Etive. This form has never been taken in any of the lochs of the Clyde sea-area, although *Euchæta norvegica*, with which it is associated in Loch Etive, occurs abundantly in Upper Loch Fyne and Loch Goil. *Nyctiphanes norvegica* and *Boreophausia Raschii*, which are abundant in the upper lochs of the Clyde sea-area, do not, on the other hand, occur in Loch Etive.

THE French Minister of Public Works has addressed a circular letter to civil engineers, asking them to use their influence to protect prehistoric monuments from the injury often done by ignorant proprietors. It seems that little respect is shown for such monuments in some parts of France. *La Nature* speaks of a proprietor who sold "a magnificent dolmen," which was to be transformed into "a tomb in a cemetery."

IN his report, for 1890, to the trustees of the Peabody Museum of American Archæology and Ethnology, Prof. F. W. Putnam, the Curator, records that in no former year had the friends of the Institution been so generous in giving aid. Gifts for current expenses were received which, in the sum total, exceeded the regular income from the funds; and Mrs. Mary Copley Thaw, of Pittsburg, added no less than 30,000 dollars to the amount held in trust, this sum being set apart as an endowment for a fellowship.

AN apparatus has been recently constructed by M. Ducretet, for getting quickly in the laboratory a fall of temperature 70° to 80° C. below zero, by means of the expansion of liquid carbonic acid. The inner of two concentric vessels contains, in alcohol, a serpentine metallic tube communicating through a tube with two stopcocks, with the carbonic acid reservoir outside, and opening below into the annular space round the inner vessel, in which are some pieces of sponge impregnated with alcohol. This two-walled vessel with coil is inclosed in a box. One stopcock being opened wide, the other slightly, the carbonic acid passes through the coil as snow, and turns to gas, with strong cooling effect, and any of it not vaporized in the coil is dissolved in the alcohol of the sponge. The gas escapes through a tube passing through the outer box. The instrument, called a *cryogen*, is represented in *Cosmos* of June 27.

EXPERIMENTS have lately been made by Herr Regel (*Bot. Centralb.*) with reference to the influence of external factors on the smell of plants. In the front rank appears the direct and indirect influence of light on the formation of etheric oils and their evaporation. In the case of strongly fragrant flowers (as *Reseda*) heat and light intensify the fragrance, which in darkness is lessened without quite disappearing. When the whole plant was darkened, those buds only which were before pretty well developed yielded fragrant flowers; the others were scentless. If, however, only the flowers were darkened, all were fragrant. Other plants open their flowers and smell only by night (as *Nicotiana longiflora* and *Nycterinia copensis*). When these plants were kept continuously in the dark, they, in course of time, lost their scent, as they lost their starch. On being brought into light again, both starch and fragrance returned. Besides light, respiration has a decided influence on the fragrance. Nycterinia, inclosed in a bell jar with oxygen, behaved normally, but with hydrogen the flowers did not open, and had no fragrance. In general, the opening of flowers coincides with their fragrance, but there is no necessary connection between these phenomena.

A NEW antiseptic, said to have certain advantages over those hitherto in use, has been brought before the French Academy of Medicine by Prof. Berlioz, of Grenoble: extreme solubility, harmlessness, efficacy, and rapidity of action are claimed for it. It is called *microcidine*, and is a compound of naphtol and soda, is neither poisonous nor irritant, is twenty times as active as boric acid, and much more soluble than thymol, carbolic acid, &c. Microcidine has the form of a greyish-white powder. In a solution of 3 grammes per litre it is very slightly coloured, but it does not stain either the hands or bandages. For family use it is said to be of great service.

MOST Russian geologists are now of opinion that the boulder-clay which covers the whole of Middle Russia is nothing but the bottom moraine of the ice-cap which, during the Glacial epoch, extended from Scandinavia and Finland to the latitude of Kieff and Poltava. A couple of years ago, Prof. Pavloff, while working in connection with the Geological Survey in Nijni Novgorod, indicated some traces of an inter-glacial milder period among the glacial deposits covering the province. Like indications have been noticed in Poltava and Tchernigoff. New data to confirm this view are now given by N. Krischtafovitch in the *Bulletin* of the Moscow Naturalists (1890, No. 4). After a careful exploration of the Quaternary deposits at Troitzkoye—a village on the Moskva River, seven miles to the west of Moscow, the diluvial deposits of which have very often been mentioned since Prof. Rouillier's and Murchison's times—the Russian geologist came to the conclusion that these deposits are indicative of an inter-glacial period, during which Middle Russia had a flora and fauna much like those which exist now, but with the addition of the Mammoth. The layers described by M. Krischtafovitch as inter-glacial are of lacustrine origin; they are covered with undoubtedly glacial deposits, and they are deposited over glacial sands containing boulders of northern origin. Further research, however, is wanted. It is certain that, both during the first invasion of the ice-cap and its ultimate retreat, its outer limits must have been subject to very great oscillations. We know that, in Greenland, parts of valleys which for hundreds of years were covered with vegetation, are sometimes invaded again with ice, and that lacustrine deposits must arise in this way between purely morainic deposits. The same must have taken place in the ice-cap of Russia; and the oscillations of the glaciers on the outer border of a large ice-cap are on on a much greater scale than the oscillations of isolated glaciers in Alpine regions. When the ice-cap began to invade Middle Russia, its advance was undoubtedly accompanied by many oscillations; regions invaded by ice must have been set free of ice for a succession of years, and they became the seats of lakes. The same oscillations must have taken place during the retreat of the ice-cap. The existence of a warmer inter-glacial period, therefore, though not improbable in itself, can be proved only by means of a very wide exploration of the boulder-clay, and such an exploration has not yet been made.

THE system of meteorological observations in Alsace-Lorraine has now been centralized, a meteorological service for the Reichsland having been established. The control of the new service has been intrusted to the geographical seminary in connection with the Strassburg University, and has been definitely undertaken by Dr. H. Hergesell, who desires to organize the service in accordance with the best modern ideas. A meteorological record will be issued as a part of the German meteorological *Jahrbuch*.

A REMARKABLE series of three hailstorms which passed over Graz on August 21 last year, about 5, 6, and 7 p.m. respectively, has been carefully studied by Prof. Prohaska (*Met. Zeits.*) Stones from 1·6 to 2·4 inches in diameter fell in the town, forming a compact ice-mass, in some places about 3 feet thick, and a white cloud of vapour formed over the ice. It is noteworthy that all three storms took a nearly quite straight path over mountain, valley, and plain; no influence of mountains on the direction was perceptible. The advancing strips of hail were 10 to 14 km. in width; the first went 173 km. east-south-east; the second and third almost exactly east; one 110 km., the other 201 km. The 70 km. stretch of country from Stiwoll over Graz to the Hungarian border lay in the path of all three, so the ice deposited by the first offered no hindrance to the others. Mountains seem to have affected the velocity, if not the direction, of the storms; they were passed more slowly than plains or undulating ground (35 km. an hour against 49 km.). A violent wind came out from the hail column, a west or north-west wind in front, north on the south side. But further out, in front especially, there was a well-marked air-current towards the hailstorm; and this was especially strong on the lee side of a mountain. Whirling movements were not observed, and there was but little thunder and lightning. The falls of temperature were very pronounced: *e.g.* in the first storm from 26° C. to 5°. The barometer went down before each hailstorm, then suddenly rose.

AT the meeting of the Linnean Society of New South Wales on May 27, Mr. Henry Deane stated that in April, while travelling by night through the Big Scrub in the Richmond River District, his interest was aroused by the remarkable effect produced by luminous insects which abounded by the roadside. Specimens were secured and sent off in the hope that they would arrive in time to be exhibited at the previous month's meeting, but they came a day too late, and in the meanwhile had died. From their general resemblance to the larvæ of *Ceroplatus mastersi*, Sk., which are also phosphorescent, Mr. Fletcher, who had seen the specimens forwarded, was of the opinion that these were very probably also dipterous larvæ. Mr. David made some remarks on certain luminous organisms which he had observed in old coal-mine workings in Illawarra, the identification of which it was hoped would not long be postponed.

MESSRS. CASSELL AND CO. have issued Part 33 of the "New Popular Educator," which is to be completed in forty-eight parts. The present number includes, besides the illustrations in the text, a coloured representation of insectivorous plants.

THE first volume of Messrs. Whittaker's new "Library of Popular Science" will be an elementary introduction to astronomy, by Mr. G. F. Chambers. The volume will be ready in the course of a few weeks, and will shortly be followed by others.

AN interesting report, by Mr. Campbell, of the British Consular Service in China, has been issued by the Foreign Office. It is the record of a journey of over 1300 miles in districts in Northern Corea, many of which have never before been visited by Europeans. Mr. Campbell started from Seoul, the capital, and crossed the peninsula to the treaty port of Won-san (Gensan), and thence pursued his way along the east coast around Broughton Bay, whence he turned north-eastward, crossing the Yalu River to Päik-tu-San, known to Europeans as the Long White Mountain, and already visited by Messrs. James, Fulford, and Younghusband. The return journey was partly over the same ground, but on arriving at Won-san Mr. Campbell recrossed the peninsula, and so made his way to Seoul. Besides the ordinary record of this journey Mr. Campbell gives a great amount of information on various subjects connected with Corea. The chief amongst these is a most interesting section on the prevalence of Buddhism in the peninsula, and one on the agriculture and productions. He gives a good deal of information in regard to the geography of Northern Corea, and also of the gold production of the country. That Corea contains gold-bearing strata has long been known through the export of gold-dust from the ports, but from Mr. Campbell's report it appears that gold-fields do exist in considerable numbers, and that some of them are worked with the imperfect native methods. There seems no doubt that, if circumstances were favourable to the proper scientific working of the Corean gold-fields, the country would be one of the principal producers of the precious metal in the world. Education in the country seems to be at a very low ebb, and is confined to a knowledge of Chinese. All energy and enterprise is crushed out by an all-pervading tyrannical officialism, and poverty and squalor are universal.

THE new reports of the Inspectors of Sea Fisheries are interesting chiefly for the observations of Mr. Fryer on the oyster fisheries. He mentions the appearance of a curious disease in the neighbourhood of the Thames estuary, in the course of which the shells become so rotten that they will not bear the pressure necessary to open them. The oysters themselves were in good condition, but their round shells, which were muddy, were completely tunnelled in all directions, while the flat valves, which were clean, were uninjured. This points to the conclusion that the ravages were caused by some enemy working from below. The borings were not, Mr. Fryer says, those of either *Cliona* or whelk-tingle, and it seemed probable that they were the work of a minute Annelid which was present in abundance in the interstices of the shells, and in the adherent mud. In a further example sent to him in June no worms were present, although the oyster-shells were similarly undermined; but their place was taken by larvæ closely resembling, if not identical with, those of the worm *Polydora ciliata*. A means of guarding against its ravages, suggested by Mr. Fryer, is the use of an apparatus recently invented by M. Bouchon Brandély, and employed in some of the French oyster *parcs* for the purpose of facilitating the growth of oysters. This consists of a series of shallow flat baskets or trays of wire-netting on an iron frame, about 4 inches deep and 2 feet square, placed in tiers, and held together by two iron bands, the number depending on the depth of water in each case. These are either fixed to the soil, or suspended from rafts or other floating bodies, by which means depths of water otherwise inaccessible can be utilized. The other advantages claimed for the apparatus are economy of space in "planting" oysters, and of labour in collecting them, protection of the oysters from five-fingers, and from contact with unsuitable soil, and their exposure on all sides to the free circulation of the water, resulting in more rapid and regular growth, and a greater tendency to depth of shell than under the most favourable of ordinary circumstances. In the case of beds infested with the boring worm referred to, the trays in question would in all probability afford a ready means of placing the oysters beyond the reach of these marauders. The convenience of such appliances, especially in cases where French oysters are laid down temporarily on English beds, to be afterwards transferred to other grounds, *e.g.* during the winter, would probably be found to be very great.

AT a meeting of the Chemical Society held on June 18, a paper was read by Ludwig Mond and F. Quincke, on a volatile compound of iron and carbonic oxide. The authors describe experiments from which they conclude that iron forms a volatile compound with carbonic oxide of the formula $Fe(CO)_4$, corresponding to that of nickel. Very finely divided iron—obtained by reducing iron oxalate by hydrogen at a temperature but little exceeding 400°, and allowing it to cool to 80° in hydrogen—when heated in an atmosphere of carbonic oxide gave a gas which burnt with a yellow flame; and on passing the gas through a heated tube a mirror of iron was formed at between 200° and 380°, while at higher temperatures black flakes of iron and carbon were deposited. Only about 2 grams of iron, however, were volatilized after six weeks' treatment of 12 grams of the metal; it was necessary every five or six hours to interrupt the operation, and to re-heat the iron to 400° in hydrogen during about twenty minutes. When passing carbonic oxide at the rate of about 2½ litres per hour, not more than 0·01 gram of iron was volatilized, corresponding to less than 2 c.c. of the compound $Fe(CO)_4$ in a litre of gas. The authors have effected an analysis of the compound by passing the mixture of gases into mineral oil, boiling between 250° and 300°, and heating the solution so obtained to 180°; iron free from carbon is then deposited and carbonic oxide gas is evolved. Five analyses are quoted, the results of which give a ratio of Fe : CO, varying only from 1 : 4·03 to 1 : 4·264. Dr. Armstrong said that the authors' discovery was extremely interesting on account of the explanation which it might be held to afford of the permeability of iron by carbonic oxide at high temperatures, as well as to the production of steel by the cementation process, to which Graham had drawn special attention. Just as platinum was permeable by hydrogen and silver by oxygen at high temperatures, so iron was permeable by carbonic oxide; it might be supposed, in each case, because a dissociable compound of the metal with the gas was formed. Prof. Thorpe drew attention to the value of the experiments in connection with the production of steel by the cementation process, and stated that he had recently observed that platinum had the property of causing the separation of carbon from carbonic oxide. Mr. Mond said they had refrained from discussing the application of their discovery in the directions indicated, as the compound was only obtained at low temperatures. Dr. Armstrong said this might well be the case; but as Mr. Mond and Dr. Quincke had established the all-important fact that iron had a specific affinity for carbonic oxide, the argument he had used would apply, although the compound might not be sufficiently stable at high temperatures to exist alone.

THE additions to the Zoological Society's Gardens during the past week include a Chimpanzee (*Anthropopithecus troglodytes* ♂) from West Africa, presented by Major Al. McDonnell Moore; a Duyker Bok (*Cephalophus mergens* ♂) from South Africa, presented by Mr. A. Barsdorf; five West Indian Agoutis (*Dasyprocta antillensis*) from Jamaica, presented by the Board of Governors of the Institute of Jamaica; a Spotted Cavy (*Cœlogenys paca*) from Guiana, presented by Mr. R. Kirk; two Slow Loris (*Nycticebus tardigradus*), a Javan Fish-Owl (*Ketupa javanensis*) from Java, presented by Mr. R. Dixon; an Orange-cheeked Waxbill (*Estrelda melpoda*), a Zebra Waxbill (*Estrelda subflava*) from West Africa, a Nutmeg Finch (*Munia punctularia*) from India, presented by Mrs. Harris; a Chattering Lory (*Lorius garrulus*) from Moluccas, presented by Miss Alice Dundas; a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain; four Grey Parrots (*Psittacus erithacus*) from East Africa, deposited; a Thar (*Capra jemlaica*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

LUMINOUS OUTBURST OBSERVED ON THE SUN.—*Comptes rendus* for June 22 contains the information that on June 17, at 10h. 16m. Paris mean time, M. Trouvelot observed a luminous outburst on the sun, apparently of the same character as that witnessed by Carrington and Hodgson in 1859 (*Monthly Notices R.A.S.*, vol. xx. pp. 13–16). A luminous spot subtending an angle of 3° appeared near the western limb of the sun (position-angle 281°). It had not the characteristic white colour of faculæ, but was yellowish, and strikingly resembled the light emitted by incandescent lamps shortly before they reach their maximum brilliancy. M. Trouvelot's first impression was that an opening at the eye-piece allowed a ubiquitous sunbeam to fall upon the screen upon which the sun's image was being projected, but an examination proved that the phenomenon was truly solar. In fact, shortly after the time of the first observation, a similar brilliant object subtending an angle of about 5° or 6° appeared slightly to the north of the first, its position-angle being about 289°. By means of spectroscopic observations it was found that the first object consisted of a central eruption from which a species of incandescent volcanic bombs were thrown to heights of 2′ or 3′ above the chromosphere, where they rested as if suspended, and appeared as dazzling globes on the red background on which they were projected. A few minutes later the sparkling balls were replaced by numerous brilliant filaments or jets, which at 10h. 24m. were shot out to a height of 5′ 24″. In spite of the vivid light of this prominence only a few lines in the spectrum were seen to be reversed. In addition to the lines C, D_3, F, and G, which were all extremely bright, the line at λ 6676·8, the *b* group, and a line about λ 4394·8, were seen bright. The sodium lines, D_1 and D_2, showed no indication of reversal. Considerable displacements of the C line towards both ends of the spectrum were observed. On the following day at 9h. 30m. the eruption was still very apparent, but diminishing in activity, and at 2h. 45m. all signs of an eruptive prominence had disappeared. The striking character of the outburst led M. Trouvelot to suggest that it might be accompanied by a simultaneous terrestrial magnetic perturbation. This was not the case, however, for after examining the records obtained at Kew Observatory, Mr. Whipple writes that there was not the slightest magnetic disturbance on the dates when the eruption was observed.

LORD HARTINGTON ON TECHNICAL EDUCATION.

THE fourth annual meeting of the National Association for the Promotion of Technical and Secondary Education took place on Friday last at 14 Dean's Yard, Westminster. Lord Hartington, President of the Association, occupied the chair. He said:—

In opening the proceedings it will be, fortunately, unnecessary for me to trouble you with more than a very few brief observations. It has not been considered necessary to make any attempts to obtain a very large attendance to-day, or to meet in any place where we could have a meeting on the scale of others which we have had on this subject in previous years, not but that we have arrived at a very important epoch in the development of the objects for which this Association was founded four or five years ago. It may, perhaps, be desirable for me, in the first place, to call your attention and the attention of the public to the special objects for which this Association has been founded, as I think there is in some quarters some misapprehension as to the practical nature of the objects which we have in view. As is stated in the report, its object has not been to interfere with the teaching of trades in workshops, or with the industrial and commercial training in the manufactory and in the warehouse. It desires, first of all, to develop increased general dexterity of hand and eye among the young, which may be especially useful to those who have to earn their own livelihood, and at the same time improve rather than hinder their general education; secondly, to bring about more widespread and thorough knowledge of those principles of art and science which underlie much of the industrial work of the nation; and, thirdly, to encourage better secondary instruction generally, which will include more effective teaching of foreign languages and science, for those who have to guide our commercial relations abroad and to develop our interests at home. Now, those are the objects to carry out which this Association was founded. At the time when it was first originated, these objects were very little recognized in any quarter. They were not recognized as in any degree the duties of the State, except to a very limited extent, so far as the operations of the Science and Art Department were concerned. But, useful and valuable as has been the teaching carried on under the guidance and direction of the Science and Art Department up to a very short time ago, I think it may be said that scarcely any attempt had been made to give to that teaching a practical application, or to apply its instruction to the advancement and improvement of the industries of the country. Well, the absence of any State recognition was not to any large extent supplied at that time by private efforts. It is quite true that a few manufacturers in different parts of the country had set the very useful example of establishing, in connection with their works, some technical and scientific teaching. There were also a few institutions, such as the well-known Polytechnic Institution here, others in the City and in various other parts of the country, which were making attempts to give instruction with the objects which I have just enumerated, but those efforts were rather of a philanthropic than of a practical character, and they had not four or five years ago attained a very large or extensive development. Well, we may look back now at those years as years of very great and very satisfactory progress. I will not say all that has been done has been done in consequence of the exertions of this Association. Certainly these objects have been greatly advanced since the foundation of the Association, and, we flatter ourselves, to a certain extent in consequence of the efforts of the Association. But whether the progress that has been made has been in consequence of, or independent of, any exertion of ours, it is equally a matter of congratulation that progress has been made. In the first place, those objects to which I have already referred have been recognized by Parliament as proper objects to receive assistance, by means of public funds, in the shape of the application to them of the rates. By the Technical Instruction Act, which was passed in 1889, mainly at the instance of some active Parliamentary representatives of this Association, that principle was for the first time admitted; but a very much greater step was taken in the next year, 1890, when, under the Local Taxation Act, a sum very nearly approaching £750,000 for England and Wales was placed at the disposal of local authorities, mainly for the objects which this Association has in view. It is quite true that the application of that sum was to a large extent optional. It would have been in the power of local authorities in whose hands it was placed to apply it in aid of the rates or to other purposes, but the efforts of the Association were directed, as I think I shall be able to show you, with very great success, in order to secure the appropriation of these large funds to the purposes of practical technical instruction. You will recollect that in the winter of last year—I think in December—an important conference was held under the direction of the Executive Committee of this Association at the rooms of the Society of Arts, in which members representing County Councils in various parts of the country entered into conference and discussion with the Executive Committee of this Association. Information was given as to what had already been done by certain County Councils which had taken the lead, and suggestions were made as to the manner in which other Councils could most usefully follow their steps and devote these sums to the purposes for which we believe they were intended by Parliament. The results which have already been accomplished are recorded in the report of this Association, which will be immediately circulated. Of County Councils in England, excluding Monmouthshire, 37 have already decided to give the whole of this grant for the purposes of technical instruction; 8 have decided to give a part of this grant for the same purposes, and 2 only have decided to apply the whole of it in aid of the rates. In Wales and Monmouthshire 11 County Councils have given the whole to education, and 2 have given a part to the same purpose. Of the county boroughs in England, 33 have devoted the whole of the funds to educational purposes, and 3 have devoted a part to the same objects. In Wales 2 county boroughs have devoted the whole of the fund to education, and none to any other purposes. With regard to 23 county boroughs, either we have not sufficient information, or they have not yet arrived at a conclusion upon the subject. Well, that appears to us to be an extremely encouraging result so far as it has gone. The exertions of the Executive Committee have not, however, been entirely confined to securing this appropriation of the funds placed at the disposal of the Councils by Parliament. The same gentlemen who have taken the lead in the matter from the beginning—I refer chiefly to my friend Sir Henry Roscoe, Mr. Acland, Mr. Hobhouse, and others—have obtained from Parliament additional legislation considerably extending and developing the principle which for the first time received the assent of Parliament in 1889. I think it is hardly necessary that I should give further information as to the effect of the amending Act of this session. I prefer to leave the gentlemen I have named to give that explanation. But I desire, however, to point out that the work of this Association, which has been so successfully begun, has not by any means yet ended. The application of these grants in the various localities is, of course, a work of great variety and of the utmost importance. Fortunately, I think, the State has not undertaken, except under very wide conditions, to exercise any supervision over the application of these funds. In a country possessing industries of so extremely varied a character as ours, it would have been almost impossible, and I think certainly would have been most undesirable, that any cut-and dried system should be adopted by which one identical, application of public money to purposes of technical instruction should be adopted all over the country. The application of these funds must vary very greatly in agricultural districts, and in agricultural districts themselves as between arable and dairy or cheesemaking districts. It must vary in those districts which are chiefly devoted to cotton and woollen industries, and those which are chiefly employed in the coalmining, metal, or chemical trades; and in almost every different county of England a different application of those resources would have been required. I think very wide discretion has been very wisely left by Parliament to the local authorities themselves, which are in this instance County Councils or county borough councils. And these Councils have again adopted the wise course of appointing committees to prepare schemes for the approval of the Councils for the application of these grants. The work was, of course, very new to a great many who had to take it up, and this Association has been able, we think, to give valuable assistance to them, both by affording information and giving advice, and, above all, by providing the means of communication between those who are interesting themselves in this work in various parts of the country, to enable them to know what other authorities were doing, what difficulties were found, what means had been found of surmounting those difficulties, and of generally taking counsel and acting together in co-operation. Now, the subject of agricultural education, which up to a very short time ago had been almost entirely neglected, has been by many County Councils vigorously taken up. Courses of instruction in elementary science applying to agricultural pursuits have been instituted, and also instruction of a still more practical character, in the shape of travelling dairies and other instruction of the same kind, has been given in many places. I am glad to say that the two great Universities of Oxford and Cambridge have also turned their attention to this important subject, and both of them are preparing to take steps by which the teachers who will be so much required in order to give effect to the desire of the County Councils to improve the agricultural education of their districts will be provided. I am glad to say also that the important subject of the technical education of girls as well as boys is receiving almost universal attention from County Councils. Suggestions have been made by this Association, which have in most cases received attention, to provide not only for the instruction of the boys, but also of the girls, in such subjects as cookery, laundry-work, and dairy management. In all these matters the Association has been able to give some assistance, and we believe that there remains a great deal still in which they will be able to afford the same nature and description of assistance. I need not say, ladies and gentlemen, that for a very considerable time the work which is likely to be thrown upon this Association will be work which cannot be conducted without considerable financial resources. The income of the Association is not a very large one. We have made an appeal to many of those who throughout the country have interested themselves in this work in connection with County Councils, and we have received very liberal assistance. I think, however, the time has come when we may hope that the efforts which have been made will be to a certain extent, still more than they have hitherto been, supplemented by the assistance of gentlemen connected with the great manufacturing, mining, and commercial industries of the country, who are likely, I think, to derive at least as much benefit from the operations of this Association, and from the development which it has aided in giving technical instruction throughout the country, as the agricultural industry has already received. Ladies and gentlemen, I must apologize to you for the imperfect character of these observations, which I have been obliged to condense as much as possible, as my time, and I dare say yours, is extremely limited. I only hope that any omissions which I have made will be supplied by my friends who are on each side of me.

Sir H. Roscoe, M.P., presented the report of the work of the Association during the past year. He said that there was no doubt that during the year a very great expansion of the work of the Association had been seen under both the Acts of Parliament to which reference had been made by the Chairman. The spread of technical education throughout the country had been most remarkable. From what had already been said by Lord Hartington, it would be concluded that practically the whole of England had devoted the whole of the money to technical instruction. The effects of this could scarcely be over-estimated. The only two places where the money had been devoted to the relief of the rates were, he regretted to say, London and Middlesex. But it should be borne in mind that what had been already accomplished was nothing to what remained to be done. The County Councils were as yet only breaking the ground. Their efforts were merely tentative. They had, as it were, to work out their own salvation in this matter of education, and there was certain to be at no great distance of time an Intermediate Education Act for England. Referring to the Act of 1891, he said that it was important and valuable because it enabled a County Council to go out of its own district if it thought necessary to promote technical education. Under that Act, for instance, the three Ridings of Yorkshire had been able to vote money to assist the Yorkshire College in its scheme for the improvement of agricultural education. Many of the County Councils had already appointed organizing secretaries, and it was on these that the main part of the work would fall. To them they had to look for the special organization of each particular district, and the importance of their work could scarcely be overrated. Then in the county boroughs the work was being got into shape. In Sheffield a sum of £8495 had been appropriated towards assisting institutions giving technical and secondary education. In the same way in Manchester £10,200 had been devoted to a like purpose. Agricultural education was making rapid progress, and already in Yorkshire, Durham, and Wales there was the nucleus of high class agricultural colleges. After referring to the necessity of some part of the money being devoted to the technical instruction of girls, he concluded by expressing the hope that the Association would be placed in a position by an increase of its resources to carry on actively a work that was daily becoming more important and more costly.

On the motion of Mr. H. Hobhouse, M.P., seconded by Lord Thring, the report was unanimously adopted.

Lord Hartington at this point left the chair, which was taken by Sir Bernhard Samuelson.

Lord Monteagle moved the reappointment of the vice-president, executive committee, and officers of the Association, the name of Mr. Bryce, M.P., being substituted for that of the late Earl Granville. Dr. Gladstone seconded, and Mr. Snape supported, the motion, which was carried unanimously.

Mr. Bryce, M.P., proposed the following resolution:—

"That this Association heartily congratulates the County Councils of England and Wales on the great progress they have made during the past year in the promotion of education in their districts, and earnestly trusts that they will continue to work until the country is provided with an organized system of secondary and technical education."

Miss Hadland seconded the resolution, which was agreed to.

Sir John Lubbock, M.P., proposed, and Mr. Rathbone, M.P., seconded, a vote of thanks to the Chairman, and this having been heartily accorded was acknowledged by Sir Bernhard Samuelson.

The proceedings then terminated.

SCIENTIFIC SERIALS.

IN the *Journal of Botany* for May, Prof. R. J. Harvey-Gibson has an interesting article, illustrated, on the histology of *Polysiphonia fastigiata*. In the June number, Mr. A. W. Bennett contributes a short paper on sexuality among the Conjugatæ. These numbers also contain continuations of Mr. E. G. Baker's synopsis of the genera and species of Malveæ, and of the Rev. H. G. Jameson's useful key to the genera and species of British mosses.

THE papers in the *Botanical Gazette* for April and May are concerned almost exclusively with American botany. Mr. D. M. Mottier has an interesting note on the apical growth of Hepaticæ, which bears such a striking resemblance to that of the prothallium of ferns.

THE number of the *Nuovo Giornale Botanico Italiano* for April is chiefly occupied by papers of special interest to Italian botanists, and by the Bulletin of the Italian Botanical Society. Among the articles coming under the latter head is one by Sig. Baccarini on the secretory system of the Papilionaceæ, and one by Sig. Pichi containing an account of experiments on the parasitism of *Peronospora* on the vine.

THE *Botanical Magazine* of Tokyo still contains occasional articles in the English language. Those in the numbers most recently received, for March and April, relate to the native plants of Japan.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 11.—"A Study of the Planté Lead—Sulphuric Acid—Lead Peroxide Cell, from a Chemical Standpoint. Part I." By G. H. Robertson. Communicated by Prof. Armstrong, F.R.S.

The investigation, the results of which are recorded in this paper, was instituted about a year ago at the Central Institution, at Dr. Armstrong's suggestion, as McLeod's observations on the electrolysis of sulphuric acid solutions led to the supposition that the changes occurring in the acid were probably less simple than was commonly supposed. This supposition was verified.

The first section of the paper deals with the nature of the lead salt formed during discharge. Experiments made on various samples of red lead of different percentage composition showed that, as with nitric, so with sulphuric acid, it behaved like a mixture of peroxide and monoxide, the sulphate formed always corresponding to the monoxide originally present.

As analysis alone can give no proof of the existence of a definite homogeneous sulphate corresponding to red lead; evidence must be obtained that the product differs in some of its properties from a mixture. It was to be expected that the E.M.F. of an oxysulphate would differ from a corresponding mixture of sulphate and peroxide, and have some definite value, but experiments made with mixtures of sulphate and peroxide in different proportions, and with the product obtained by treating red lead with dilute sulphuric acid, showed that there was a difference of degree only between the red lead pastes and the mixtures.

With regard to Frankland's observations respecting the colour of the product formed on the peroxide plate during discharge, and the reducibility of the sulphate, the author points out that the colour is due to the incomplete reduction of the peroxide; and that careful examination of the plugs from a discharged cell shows that the base consists of practically unaltered peroxide of lead, and that the surface, which is rich in $PbSO_4$, is really a mass of partially reduced granules of peroxide of lead which are coated with sulphate.

Also, though pure lead sulphate is very difficult to reduce, it is well known that mixtures of lead sulphate and peroxide of lead, or other conducting substances, are reduced with comparative ease, and that it is very intimate mixtures of this nature which have to be dealt with as a rule in charging a cell.

In conclusion, the author points out—

That neither chemical nor electrical tests give any ground for supposing that any other sulphate than the ordinary white $PbSO_4$ is concerned in the interactions occurring in the cell;

That were the sudden lowering of the E.M.F. caused by a change in the nature of the chemical compounds formed on the plates, it is very difficult to account for the very rapid recovery of the E.M.F. exhibited by an apparently discharged cell.

In the second section the electrolyte is dealt with, and, after referring to the work of Berthelot, Richarz, Schöne, Traube, and others on the electrolysis of sulphuric acid solutions, the author describes experiments made to test the effect of the addition of sodium sulphate to the electrolyte, as recommended by Mr. Barbour Starkey, as it seemed probable it had a catalytic action on the "peroxides" always found in electrolyzed acid of the strength used in batteries.

Mr. Preece most kindly aided the investigation by allowing experiments to be carried out at the General Post Office, where one-half of the secondary cells contain 1 per cent. of sodium sulphate, and the other half ordinary dilute acid, sp. gr. 1180. It was found that the addition of sodium sulphate in about the proportion of 1 per cent. to freshly electrolyzed acid, or during electrolysis, always produced a diminution in the total quantity of "active oxygen," and brought the amount present in the plain cells down almost exactly to that found in the sodium sulphate cells.

Determinations were made of the amounts of "active oxygen" present as persulphuric acid and hydrogen dioxide respectively; and it was established that acid taken from the cell reduced peroxide of lead. The presence of hydrogen dioxide being thus established both directly and indirectly, its effect on the E.M.F. of a cell was tested. It was found that, while its addition to the acid in the case of a lead lead-peroxide couple in dilute sulphuric acid produced an annulment, or reversal, of the E.M.F., the introduction of hydrogen dioxide into the body of the peroxide paste produced an increase in the E.M.F. in the case of a platinum lead-peroxide couple.

The Post Office records showed that, while the general character of the temperature and specific gravity changes occurring during charge and discharge were the same in both types of cell, there was less sulphating with the sodium sulphate electrolyte.

The cause of the pink colour of the acid, noticed by Mr. Crompton and others, was investigated, and found to be permanganic acid, formed probably from the manganese present in commercial lead.

In conclusion, the author points out—

That peroxides are found in appreciable quantities in the electrolyte during charge and discharge;

That their influence must not be neglected in considering the behaviour of the Planté cell;

And that it is to the electrolyte, rather than to the plates, that attention must be directed if any considerable improvement is to be effected.

"Part II.—A Discussion of the Chemical Changes occurring in the Cell." By H. E. Armstrong, F.R.S., and G. H. Robertson.

The authors arrive in this paper at the following conclusions:—

(1) That the cooling observed in the Planté cell can only be explained as resulting from the dissociation of the dilute sulphuric acid; and as the values given by Messrs. Ayrton, Lamb, Smith, and Woods are in practical agreement with those calculated on the assumption that the acid used is sulphuric acid itself, H_2SO_4, that in all probability such acid, and not the dilute acid contained in the cell, is operative throughout.

(2) That the observed loss in efficiency cannot be due to temperature changes, as these arise through actions occurring out of circuit.

(3) That it is difficult, from a comparison of calculated with observed values of the E.M.F., to arrive at any final conclusion as to the exact nature of the changes which take place in the cell. On the assumption that sulphating occurs at both plates in circuit, and under the influence of H_2SO_4, the calculated value is considerably too high; while, if sulphating occur only at the lead plate, the value calculated is far too low.

(4) That a counter E.M.F. of about 0·5 volt would account for the observed departure from the highest calculated value. As peroxides are always present in the electrolyte, it is conceivable that such a counter E.M.F. may exist; moreover, there is also the possible influence of the lead support to be considered.

(5) That the observed loss of efficiency is to be attributed to the formation of peroxides in the electrolyte, and to the excessive sulphating occurring chiefly at the peroxide plate in the local circuit existing between the support and the paste.

June 18.—"Comparison of Simultaneous Magnetic Disturbances at several Observatories, and Determination of the Value of the Gaussian Coefficients for those Observatories." By Prof. W. Grylls Adams, D.Sc., F.R.S., Professor of Natural Philosophy in King's College, London.

After drawing attention to previous investigations on this subject, and pointing out the importance of adopting the same scale values for similar instruments at different Observatories, especially at new Observatories which have been recently established, the discussion of special magnetic disturbances is undertaken, especially the disturbances of a great magnetic storm which occurred on June 24 and 25, 1885, for which photographic records have been obtained from 17 different Observatories: 11 in Europe, 1 in Canada, 1 in India, 1 in China, 1 in Java, 1 at Mauritius, and 1 at Melbourne.

The records are discussed and compared, tables are formed of the simultaneous disturbances, and the traces are reduced to Greenwich mean time and brought together on the same plates arranged on the same time-scale. Plates I. and II. show the remarkable agreement between the disturbances at the different Observatories, and the tables show that the amount of disturbance, especially of horizontal magnetic force, is nearly the same at widely distant stations.

An attempt has also been made to apply the Gaussian analysis to sudden magnetic disturbances, and, with a view to their application in future work, the values of the Gaussian coefficients have been obtained for 20 different Observatories, and the numerical equations formed for the elements of magnetic force in three directions mutually at right angles, and also the equation for the magnetic potential in terms of the Gaussian constants to the fourth order.

The tables give the numerical values to be multiplied by the 24 Gaussian constants to give the values of the forces X, Y, and Z in the geographical meridian towards the north, perpendicular to the meridian towards the west, and towards the earth's centre respectively. The equations are also formed and the values obtained in terms of the 24 Gaussian constants for X_2, Y_2, and Z_2; X_2 being the horizontal force in the magnetic meridian, Y_2 the horizontal force perpendicular to the magnetic meridian, and Z_2 the vertical force. If then X_2, Y_2, and Z_2 be the observed values of any simultaneous disturbances, they may be at once substituted in the equations, the equations giving the 24 Gaussian constants may be solved, and the corresponding change of magnetic potential may be determined.

Physical Society, June 12, 1891.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—Prof. W. G. Adams took the chair whilst Prof. Ayrton read a paper on alternate current and potential difference analogies in the methods of measuring power, by himself and Dr. Sumpner. In a paper read before the Society in March last, the authors pointed out that, for every method of measuring power in which readings of volts and amperes were taken, other methods in which amperes were read instead of volts, and volts instead of amperes, could be devised. More recently, Dr. Fleming had, by a transformation of a formula given by the authors in a communication made to the Royal Society on the measurement of power by three voltmeters, given the analogue in which three ammeters were employed. The two arrangements are represented in Figs. 1 and 2, whilst Fig. 3 shows a modification of Dr. Fleming's method (Fig. 2), in which the current in the non-inductive resistance r is measured by the aid of a voltmeter V across its terminals. This obviates the necessity of putting an electro-magnetic instrument

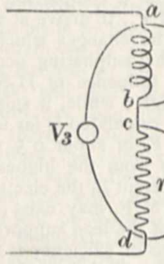

Fig. 1.

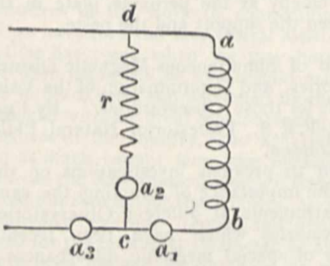

Fig. 2.

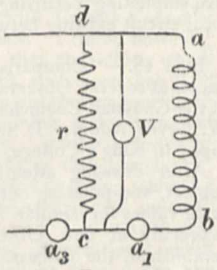

Fig. 3.

in what should be a non-inductive circuit. The formula for the mean watts spent in the circuit *ab*, Figs. 1 and 2, are respectively—

$$W = \frac{1}{2r}\left(V_3^2 - V_1^2 - V_2^2\right), \text{ and } W = \frac{r}{2}\left(A_3^2 - A_1^2 - A_2^2\right).$$

Mr. Blakesley's method of measuring power by a split-dynamometer was shown to be analogous to the original electrometer method in which the difference of two readings was proportional to the power, and Blondlot and Currie's double electrometer method was shown to be the analogue of the ordinary wattmeter. The wattmeter was defective in the fact that a solenoidal coil was inserted in a nominally non-inductive circuit. The error thus introduced is, as was shown by one of the authors some years ago, expressed by the formula—

$$\frac{\text{Apparent watts}}{\text{True watts}} = \frac{1 + \tan\theta \cdot \tan\phi}{1 + \tan^2\phi},$$

where θ is the phase angle between the current and E.M.F. in the circuit in which the power is to be measured, and ϕ the phase angle for the approximately non-inductive circuit. It is now proved that the same formula expresses the error in any of the methods where resistances not wholly non-inductive are used. As is well known, Mr. Blakesley has applied his split-dynamometer to the measurement of phase differences between two currents; and an analogous method of finding the phase difference between two potential differences is described in the paper. In this method a high resistance split-dynamometer such as suggested by Mr. Rimington for measuring power is employed. Blondlot and Currie's double electrometer could also be used for the same purpose. Numerous diagrams illustrating the various analogies accompany the paper. Prof. S. P. Thompson inquired whether hot-wire voltmeters could be employed to measure the various potential differences, without introducing error. In reply, Prof. Ayrton said that, although no great error was introduced by the self-induction of these instruments, yet the fact that they required considerable current was a disadvantage, and as these currents were not always in the same phase as those in other circuits, troublesome corrections were sometimes necessary. Electrostatic instruments were preferable. Prof. Adams said he was glad to hear that the inductance of Cardew voltmeters introduced no serious error, for they were very convenient instruments to use.—Prof. O. Lodge, F.R.S., exhibited and described a clock for pointing out the direction of the earth's orbital motion in the ether. After mentioning the various motions to which a point on the earth's surface is subjected, he pointed out that the orbital motion was the largest component, and its direction at any instant not easy to conceive. An apparatus for pointing out this direction was therefore convenient when dealing with problems requiring a knowledge of the motion of a point through the ether. In one of two clocks shown, one spindle representing the earth's polar axis and another the axis of the ecliptic were inclined at an angle of 23½°, and coupled by a Hooke's joint. The latter axis was capable of rotating round the former. At its upper end the ecliptic axis carried a tube and a pointer, both being perpendicular to the axis and to each other. The clock keeping solar time rotated both axes, and when properly set the tube pointed in the direction of the sun, and the pointer therefore indicated the direction of the earth's orbital motion.—Some experiments with Leyden jars were then shown by Dr. Lodge. The first one was with resonant jars, in which the discharge of one jar precipitated the overflow of another, when the lengths of the jar circuits were properly adjusted or tuned. The latter jar was entirely disconnected from the former, and was influenced merely by electro-magnetic waves emanating from the discharging circuit. Lengthening or shortening either circuit prevented the overflow. Correct tuning was, he said, of great importance in these experiments, for a dozen or more oscillations occurred before the discharge ceased. The effect could be shown over considerable distances. In connection with this subject Mr. Blakesley had called his attention to an observation made by Priestley many years ago, who noticed that, when several jars were being charged from the same prime conductor, if one of them discharged the others would sometimes also discharge, although they were not fully charged. This he (Dr. Lodge) thought might be due to the same kind of influence which he had just shown to exist. The word *resonance*, he said, was often misunderstood by supposing it always had reference to sound, and as a substitute he thought that *symphoning* or *symphonic* might be allowable. The next experiment was to show that wires might be tuned to respond to the oscillation of a jar discharge just as a string could be tuned to respond to a tuning-fork. A thin stretched wire was connected to the knob of a jar and another parallel one to its outer coating, and by varying the length of an independent discharging circuit, a glow was caused to appear along the remote halves of the stretched wires at each discharge. Each of the wires thus acted like a stopped organ-pipe, the remote ends being the nodes at which the variations of pressure were greatest. By using long wires he had observed a glow on portions of them with the intermediate parts dark; this corresponded with the first harmonic, and by measuring the distance between two nodes he had determined the wave-length of the oscillations. The length so found did not agree very closely with the calculated length, and the discrepancy he thought due to the specific inductive capacity of the glass not being the same for such rapidly alternating pressures as for steady ones. He also showed that the electric pulses passing along a wire could be caused (by tuning) to react on the jar to which it was connected, and cause it to overflow even when the distance from the outside to the inside coating was about 8 inches. During this experiment he pointed out that the noise of the spark was greatly reduced by increasing the length of the discharging circuit. The same fact was also illustrated by causing two jars to discharge into each other, spark gaps being put both between their inner and outer coatings so as to obtain "A" sparks and "B" sparks. By putting on a long "alternative path" as a shunt to the B spark gap and increasing that gap, the noise of the A spark was greatly reduced. He had reason to believe that the B spark was a quarter phase behind the A spark, but the experimental proof had not been completed. He next described some experiments on the screening of electro-magnetic radiation, in which a Hertz resonator was surrounded by different materials. He had found no trace of opacity in insulators, but the thinnest film of metal procurable completely screened the resonator. Cardboard rubbed with plumbago also acted like a nearly perfect screen. In connection with resonators, he exhibited what he called a *graduated electric eye* or an *electric harp*—made by his assistant, Mr. Robinson—in which strips of tin foil of different lengths are attached to a glass plate, and have spark gaps at each end which separate them from other pieces of foil. One or other of the strips would respond according to the frequency of the electro-magnetic radiation falling upon it. Mr. Blakesley asked whether the pitch of the resonant jars altered when the distance between their circuits was varied, for according to theory the mutual induction should diminish the self-induction, and cause the oscillations to be more rapid. If this occurred, the method might be used for getting rapid oscillations. He also inquired whether the glow would appear in the same position on the two stretched wires if their ends were joined. Dr. Sumpner wished to know how the resistances, inductances, and capacities of the circuits and jars were determined, and whether any evidence of irregular distribution of the charges on the tin-foil had been noted. With reference to the overflowing of a jar caused by using a certain length of discharging circuit, he asked whether the overflow did not prove the existence of a higher potential than that which originally existed between the coatings of the jar, and, if so, where did the excess energy come from? Dr. Thompson asked if it would be possible to make a wire circuit analogous to an open organ-pipe by putting sheets of metal on the ends of the wires. Dr. Lodge, in reply, said Mr. Blakesley's suggestion was an important one, but he had not observed that any change in the adjustment was necessitated by varying the distance between the resonating circuits. Neither had he noticed any glow on wires joined to form a single loop, but this might be possible if the wires were long enough to give harmonics. In answer to Dr. Sumpner he said that the capacities were difficult to determine, for with such rapid oscillations the coatings were virtually enlarged. Lord Rayleigh had shown how to calculate the inductances, and the resistances he had practically measured by his alternative path experiments. The overflow of jars he thought was caused by the charges in some way concentrating on the edges of the foil, thus causing a kind of flood tide, at which the overflow occurred. The President asked Dr. Lodge what his views were as to the cause of the opacity of ebonite to light. Was it due to a selective absorption which cut off only the rays to which the eye was sensitive, or was the ordinary explanation, that it contained impurities which were conducting, and hence acted as screens, likely to be correct? Another possible explanation was that the motion of the ether particles may be in three dimensions, and light be due to the projection of this motion on a plane perpendicular to the ray, whilst electromagnetic induction might be due to the other component. Dr. Lodge said he believed that ebonite was not opaque because of conducting particles being present, and was inclined to think that it acted more like ground glass, in which the opacity was due to internal reflections. Such a substance would only be opaque to vibrations whose wave-lengths were comparable with the size of the particles.—A note on the construction of non-inductive resistances, by Prof. W. E. Ayrton, F.R.S., and Mr. T. Mather, was postponed until next meeting.

Zoological Society, June 16.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—Mr. H. A. Bryden exhibited an abnormal pair of horns of a cow Eland obtained in the North Kalahari, and made remarks on the structure of the feet of the Lechée Antelope.—Mr. Howard Saunders exhibited and made remarks on a nearly white skin of a Tiger obtained in Northern India by Major D. Robinson.—Mr. Saunders also exhibited specimens of the eggs of a Gull (*Larus maculipennis*) and of a Tern (*Sterna trudeaui*) from Argentina.—Mr. Sclater read an extract from a letter received from Dr. Bolau, C.M.Z.S., describing two Sea-Eagles living in the Zoological Garden, Hamburg, and considered to be referable to Steller's Sea-Eagle (*Haliaëtus pelagicus*). One of these, received from Corea, Mr. Sclater pointed out, probably belonged to the species described in the Society's Proceedings by Taczanowski as *Haliaëtus branickii*.—Dr. R. Bowdler Sharpe gave a short account of the proceedings of the International Ornithological Congress recently held at Budapest, in which he had taken part.—Mr. G. A. Boulenger read a paper entitled "A Contribution to our Knowledge of the Races of *Rana esculenta* and their Geographical Distribution." Mr. Boulenger proposed to recognize four forms of this widely-spread species of Frog, and pointed out the characters upon which these races were based and the areas which they occupy.—Mr. Oldfield Thomas read some notes on various species of Ungulates, which he had made during a recent examination of the specimens of this group of Mammals in the British Museum.—Mr. Edgar A. Smith gave an account of a large collection of Marine Shells from Aden. To this were added some remarks upon the relationship of the Molluscan Fauna of the Red Sea with that of the Mediterranean.—A second communication from Mr. Smith contained descriptions of some new species of Shells, based on examples obtained during the *Challenger* Expedition.—Mr. H. A. Bryden read some notes on the present distribution of the Giraffe south of the Zambesi, and made some remarks on the best means of procuring living specimens of this animal for European collections.—A communication was read from Messrs. Mole and Urich containing notes of some of the Reptiles of Trinidad, of which they had transmitted living examples to the Society's Menagerie.—Mr. F. E. Beddard read some additional notes upon the anatomy of *Hapalemur griseus*, made during a recent examination of two specimens of this Lemur.—Mr. E. B. Poulton gave an account of an interesting example of protective mimicry discovered by Mr. W. L. Sclater in British Guiana. This was an immature form of an unknown species of Homopterous insect of the family Membracidæ, which mimics the Cooshie Ant (*Œcodoma cephalotes*).—This meeting closes the present session. The next session (1891-92) will begin in November next.

Royal Microscopical Society, June 17.—Dr. R. Braithwaite, President, in the chair.—The President said he regretted to announce the death of Prof. P. Martin Duncan, who as a past President of the Society, was well-known to the Fellows.—A negative of *Amphipleura pellucida*, produced with Zeiss's new $\frac{1}{16}$ of 1·6 N.A. and sunlight, by Mr. T. Comber, of Liverpool, was exhibited, and his letter was read suggesting that the want of sharpness was due to the employment of a projection eye-piece for a tube-length of 160 mm., whereas the objective was made for a tube-length of 180 mm. The illumination was axial with a Zeiss achromatic condenser of 1·2 N.A. Mr. Comber thought the resolution showed indications of so-called "beading," and he inferred that the ultimate resolution would be similar to that of *Amphipleura lindheimeri*. The mounting medium had a refractive index of 2·2, but was very unstable, granulations appearing in a very short time.—Mr. C. L. Curties exhibited Mr. Nelson's apparatus for obtaining monochromatic light. Mr. Mayall said the apparatus was so devised that the microscopist might employ any prism or photographic lens he possessed. If a prism was made specially, one of light crown-glass would probably answer better than the dense flint.—Mr. T. T. Johnson exhibited a new form of student's microscope which he had devised. Mr. Mayall said the special point was the application of a screw movement to raise and lower the substage, the screw being in the axis of the bearings of the substage and tailpiece; and the position of the actuating milled head, which projected slightly at the back of the stage, seemed to be most happily chosen.—Dr. J. E. Talmage, of Salt Lake City, Utah, U.S.A., a newly elected Fellow, having been introduced by the President, read a note on the occurrence of life in the Great Salt Lake, and exhibited some specimens of *Artemia fertilis* from the lake.—Prof. Bell said a paper was read at the February meeting, in which Dr. Benham described a new earthworm under the name of *Eminia equatorialis*. The name *Eminia* having been already given to a bird by Dr. Hartlaub, Dr. Benham proposed to re-name the earthworm *Eminodrilus*.—A letter from Dr. Henri Van Heurck was read, replying to the criticisms of his microscope delivered at the previous meeting. A discussion followed, in which Mr. Mayall, Dr. Dallinger, and Mr. Watson joined.—Mr. T. D. Aldous exhibited the eggs of a water-snail which were attacked by a parasite which seemed to be destroying the gelatinous matter to get at the eggs.

Royal Meteorological Society, June 17.—Mr. Baldwin Latham, President, in the chair.—Mr. A. J. Hands gave an account of a curious case of damage by lightning to a church at Needwood, Staffordshire, on April 5, 1891. The church was provided with a lightning-conductor, but Mr. Hands thinks that when the lightning struck the conductor, a spark passed from it to some metal which was close to it, and so caused damage to the building.—Mr. W. Ellis read a paper on the mean temperature of the air at the Royal Observatory, Greenwich, as deduced from the photographic records for the forty years from 1849 to 1888, and also gave some account of the way in which, at different times, Greenwich mean temperatures have been formed.—Mr. Ellis also read a paper on the comparison of thermometrical observations made in a Stevenson screen with corresponding observations made on the revolving stand at the Royal Observatory, Greenwich. From this it appears that the maximum temperature in the Stevenson screen is lower than that of the revolving stand, especially in summer, and the minimum temperature higher, whilst the readings of the dry and wet bulb thermometers on both the screen and the stand, as taken at stated hours, agree very closely together.—Mr. W. F. Stanley exhibited and described his phonometer, which is really a new form of chronograph, designed for the purpose of ascertaining the distance of a gun from observations of the flash and report of its discharge, by the difference of time that light and sound take in reaching the observer. The instrument can also be used for measuring the distance of lightning by timing the interval between the flash and the report of the thunder.—A paper was also read by Mr. A. B. MacDowall, on some suggestions bearing on weather prediction.

Geological Society, June 24.—Sir Archibald Geikie, F.R.S., President, in the chair.—The following communications were read:—On wells in West Suffolk boulder-clay, by the Rev. Edwin Hill. It might be supposed that in a boulder-clay district water could only be obtained from above or from below the clay. But in the writer's neighbourhood the depths of the wells are extremely different, even within very short distances; and since the clay itself is impervious to water, he concludes that it must include within its mass pervious beds or seams of some different material which communicate with the surface. It would follow that this boulder-clay is not a uniform or a homogeneous mass. The visible sections are only those given, at hand by ditches, and at a considerable distance north and south by pits at Bury St. Edmunds and Sudbury. The appearances in these harmonize with that conclusion. Conclusion and appearances differ from what we should expect on the theory that this boulder-clay was the product of the attrition between an ice-sheet and its bed. The reading of this paper was followed by a discussion in which Prof. Prestwich, Dr. Evans, Mr. Clement Reid, Mr. Charlesworth, Mr. Topley, Mr. Goodchild, the President, and the author took part.—On the melaphyres of Caradoc, with notes on the associated felsites, by Frank Rutley.—Notes on the geology of the Tonga Islands, by J. J. Lister. (Communicated by J. E. Marr, F.R.S.)—On the Inverness earthquakes of November 15 to December 14, 1890, by C. Davison. (Communicated by Prof. Chas. Lapworth, F.R.S.) In this paper the author gives reasons for supposing that the Inverness earthquakes of last year were due to the subsidence of a great wedge of rock included between a main fault and a branch one; and he considers that there is little doubt that these recent earthquakes were the transitory records of changes that, by almost indefinite repetition in long past times, have resulted in the great Highland faults.—The next meeting of the Society will be held on Wednesday, November 11.

PARIS.

Academy of Sciences, June 29.—M. Duchartre in the chair.—On persulphates, by M. Berthelot. Some new facts are stated in proof of the existence of persulphuric acid not merely as an anhydride, S_2O_7, but also as a compound capable of forming distinct salts, similar as regards composition to permanganates, perchlorates, permolybdates, and pertungstates.—Experiments on the mechanical actions exercised on rocks by gas at high pressures and in rapid motion, by M. Daubrée. The author shows that volcanoes of the same group have approximately the same height, and points out that it is probable that each group is the result of internal action at one centre. These considerations are applied to old volcanic rocks, which often exhibit a marked tendency to equality of level. The experiments which throw light on the disturbances investigated were previously described.—Action of sodium alcoholates on camphor: new method of preparation of alkyl camphors, by M. A. Haller.—On a cryptogam parasite of locusts, by M. Charles Brongniart.—On surfaces possessing the symmetry of plane systems, by M. S. Mangeot.—On homogeneous finite deformations: energy of an isotropic body, by M. Marcel Brillouin.—On the biaxial character of compressed quartz, by M. F. Beaulard.—The photogenic efficiency of different sources of light, by M. A. Witz.—On an electro-magnetic bell, by MM. Guerre and Martin.—Contribution to the study of atmospheric electricity, by M. Ch. André. It is generally admitted that atmospheric electricity is subject to a diurnal variation. A discussion of the observations made by M. Mascart at Lyons since 1884 shows that electric potential varies in much the same manner as barometric pressure and relative humidity. In fact, curves showing the annual variations of relative humidity and electric potential have precisely the same form.—On the oxidation of azo-compounds, by M. Charles Lauth.—On the formation of the mesentery and the intestinal canal in the embryo of the fowl, by M. Dareste.—On the sting of *Heterodera Schachtii*, by M. Joannes Chatin.—On Cladosporiæ Entomophytæ, a new group of parasitic fungi of insects, by M. Alfred Giard.—Contribution to the study of the differentiation of the endoderm, by M. Pierre Lesage.—On the destruction of *Peronospora Schachtii* of the beetroot, by means of compounds of copper, by M. Aimé Girard.—Influence of muscular exercise on the excretion of urinary nitrogen, by M. Chibret.

BRUSSELS.

Royal Academy of Sciences, April 4.—M. F. Plateau in the chair.—On the characteristic property of the common surface of two liquids under their mutual affinity, Part iii., by M. G. Van der Mensbrugghe. The observations given in the first paper indicated that the common surface of two liquids which act upon one another is subjected to a force whose direction is away from the centre of curvature. In the present note the author gives some new facts which appear to render this *force d'extension* very manifest. When a drop of olive oil is put upon the surface of distilled water, it slowly breaks up into a lens-shaped drop on the water surface and a spherical drop which descends to the bottom of the containing vessel. It is shown that a slow diminution occurs of the tension of the surface common to the oil and water. This diminution apparently arises from a slow chemical action between the two liquids, and which, if sufficiently prolonged, is manifested by the formation of a thin pellicle separating them. Many such phenomena as these are stated and explained according to the new theory.—Fourth note on the structure of the equatorial bands of Jupiter, by M. F. Terby. The author remarks that he was the first to comment upon the structure of Jovian equatorial bands, and to make known the fact that it is observable in small instruments. In a recent publication Mr. Keeler has overlooked these observations, and rendered this rectification necessary.—On the number of invariant functions by M. Jacques Deruyts.—*A propos* the rotation of the planet Venus, by M. L. Niesten (see NATURE, June 18, p. 164).—Geometrical calculation of the distances of remarkable points of triangles, by M. Clément Thiry.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Saturn's Kingdom: C. M. Jessop (Paul).—Collection de Mémoires relatifs à la Physique, tomes i. to iv. (Paris, Gauthier-Villars).—Charles Darwin: C. F. Holder (Putnam).—Solutions of Examples in Elementary Hydrostatics: Dr. W. H. Besant (Bell).—Practical Electro-Therapeutics: A. Harries and H. N. Lawrence (Low).—Popular Astronomy: Sir G. B. Airy; new edition (Macmillan and Co.).—The *Electrician* Primers, 2 vols. (*Electrician* Office).—Report on the Cahaba Coal Field: J. Squire (Montgomery, Ala.).—A Vertebrate Fauna of the Orkney Islands: T. E. Buckley and J. A. Harvie-Brown (Edinburgh, Douglas).—Manuel Pratique d'Analyse Bactériologique des Eaux: Dr. Miquel (Paris, Gauthier-Villars).—Outlines of Field Geology, 4th edition: Sir A. Geikie (Macmillan and Co.).—The History of Human Marriage: E. Westermarck (Macmillan and Co.).—Memorials of John Gunn: edited by H. B. Woodward and E. T. Newton (Norwich, Nudd).—Michigan Mining School Report 1886-91 (Marquette, Mich.)—Sommaire de Photogrammétrie: V. Legros (Paris).—Die Indo-Malayische Strandflora: A. F. W. Schimper (Jena, Fischer).—Vorlesungen über Maxwell's Theorie der Elektricität und des Lichtes, 1 Theil: Dr. L. Boltzmann (Leipzig, Barth).

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